

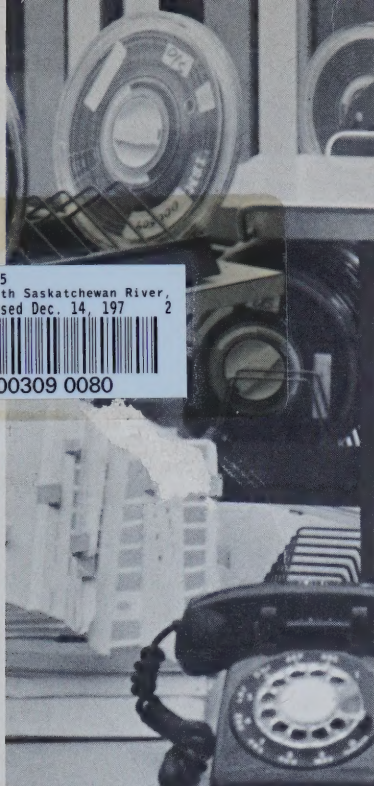
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Water Quality: North Saskatchewan River,
1971-1972. Released Dec. 14, 1972



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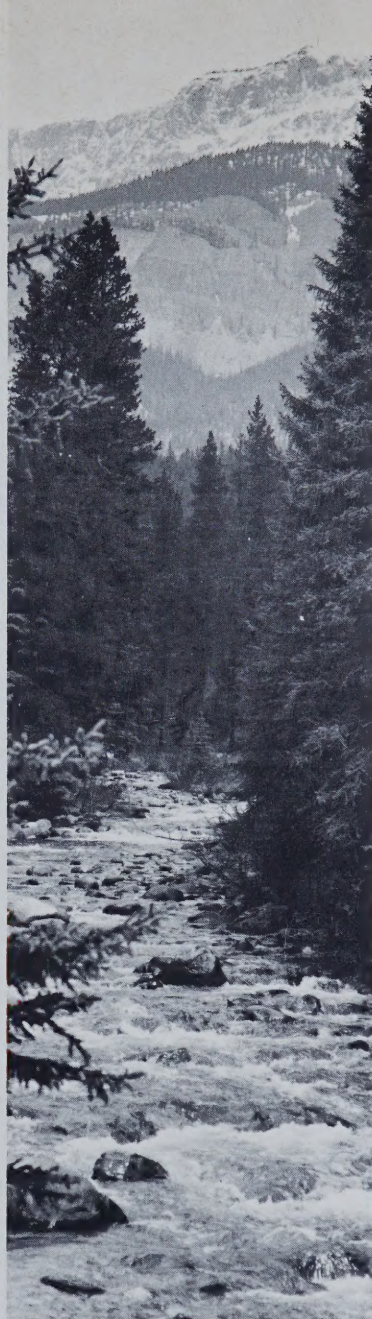


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WATER QUALITY
NORTH SASKATCHEWAN
RIVER
1971 - 1972

POLLUTION CONTROL
DIVISION

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WATER QUALITY

NORTH SASKATCHEWAN RIVER

1971 - 1972

J. P. HARRIS, P. ENG.

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WATER QUALITY
NORTH SASKATCHEWAN
RIVER

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WATER QUALITY
NORTH SASKATCHEWAN RIVER
1971 - 1972

BY

A. MASUDA, P. ENG.

PROVINCE OF ALBERTA
DEPARTMENT OF THE ENVIRONMENT
DIVISION OF POLLUTION CONTROL
6TH FLOOR MILNER BUILDING, EDMONTON

A B S T R A C T

Water quality in the North Saskatchewan River improved this past winter from the quality observed during the previous year. The improved water quality is mainly due to a higher degree of treatment of municipal waste from the City of Edmonton and greater quantity of dilution water in the river.

Improvement was noted in most constituents analyzed including Dissolved Oxygen, Phenols, Threshold Odor Number, Total Coliform and Faecal Coliform. Nutrient concentrations decreased significantly but remained above guideline values.

Metals exceeding established criteria levels were Selenium, Copper, Zinc, and Mercury. Three surveys for Metal analyses were completed during the winter.

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ESTABLISHMENT AND OPERATION OF THE PROGRAM

Many of the problems involved in the establishment and operation of the program are of practical rather than technical consideration. A summary discussion of some of the more basic considerations has been included.

PROGRAM OBJECTIVES

This program was established a number of years ago to provide basic information which would reveal pollution trends and provide water quality data for the many existing and prospective users of surface water in Alberta.

The monitoring program has these specific objectives:

1. To determine chemical, physical, bacteriological and biological characteristics of Alberta's water under changing conditions.
2. To indicate, when possible, the sources of pollution entering a stream.
3. To compile data for future pollution abatement activities.
4. To determine background data on certain types of wastes, and to detect critical changes.
5. To obtain data useful for municipal, industrial, agricultural and recreational uses.
6. To procure data useful and necessary for securing public action toward the preservation of streams for all beneficial uses.

SCOPE OF ANALYSES

The frequency of sampling is admittedly limited. In some instances a more important parameter such as dissolved oxygen is monitored continuously. The routine analyses shown in this report represent the minimum of bacteriological, biochemical and chemical analyses which justify the program.

SAMPLING STATIONS AND PROCEDURES

The following criteria were used as a basis for the selection of monitor stations:

1. Waters used for municipal, industrial, agricultural, and recreational purposes.
2. Near known or suspected sources of pollution.
3. Near the Alberta-Saskatchewan border to determine the quality of water leaving the province.

Stations were established at bridges whenever practical for convenient access to each watercourse. Routine samples included two litres for general chemical analyses, one litre each for Phenolics and Oil and Grease, and 100 millilitres in a sterile bottle for bacteriological analyses. Four litre samples were collected in a pyrex glass jar for Heavy Metals analysis.

INTRODUCTION

The rapid industrial growth that took place in the Edmonton area during the 1950's resulted in a heavy use demand on the North Saskatchewan River. The quality of the river water suffered appreciably during the ensuing decade from the discharge of trade and municipal wastes. Water quality surveys were initiated during this time to assess the performance of the river under pollution loadings and to formulate a treatment program for both industrial and municipal wastes.

Since then, improved waste water treatment and regulation of winter flows from an upstream reservoir has markedly improved river water quality. Further improvement is necessary and this is expected with the operation of a reservoir upstream and more stringent controls on industrial and municipal effluents.

DISCUSSION

MONITORING

Samples from twelve major discharge sources were coordinated with the overall river basin monitoring program. Five monthly surveys were completed during the period from November 2, 1971 to March 1, 1972. The trend has been to de-emphasize manual sampling and stress automatic monitoring with more detailed specific ion analysis. This trend will continue in the future with the addition of biological monitoring program next year.

Pesticide monitoring was temporarily discontinued this past winter. Future programs will involve analyses of bottom sediment, sludge and aquatic organisms for these pesticides.

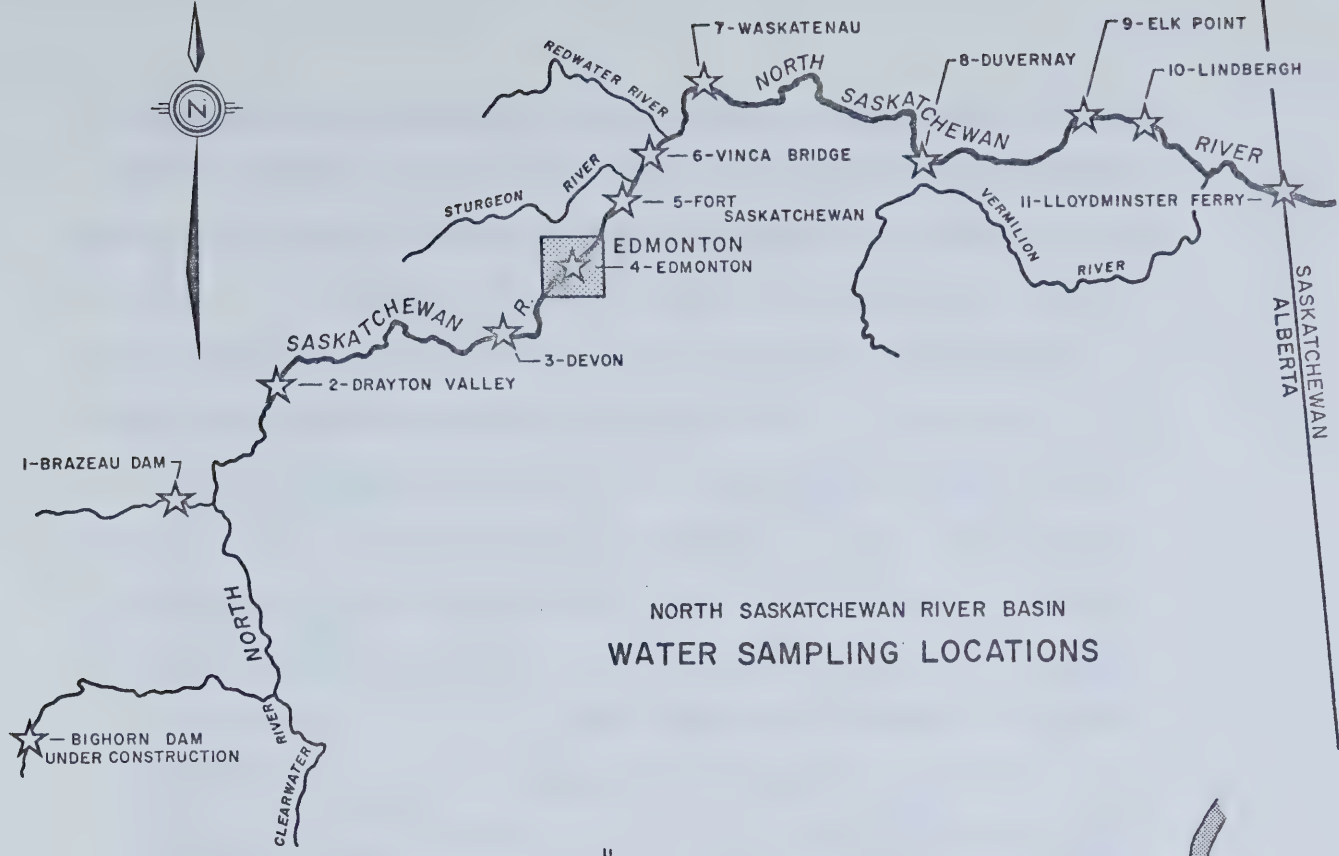
Surveys of storm sewers and snow disposal sites were completed during the snow melt period in March. Analysis included metals and a potential carcinogenic product of the internal combustion engine Benzo-a-Pyrene.

The manual sampling program consisted of monthly samples taken from the following locations (see Figure 1):

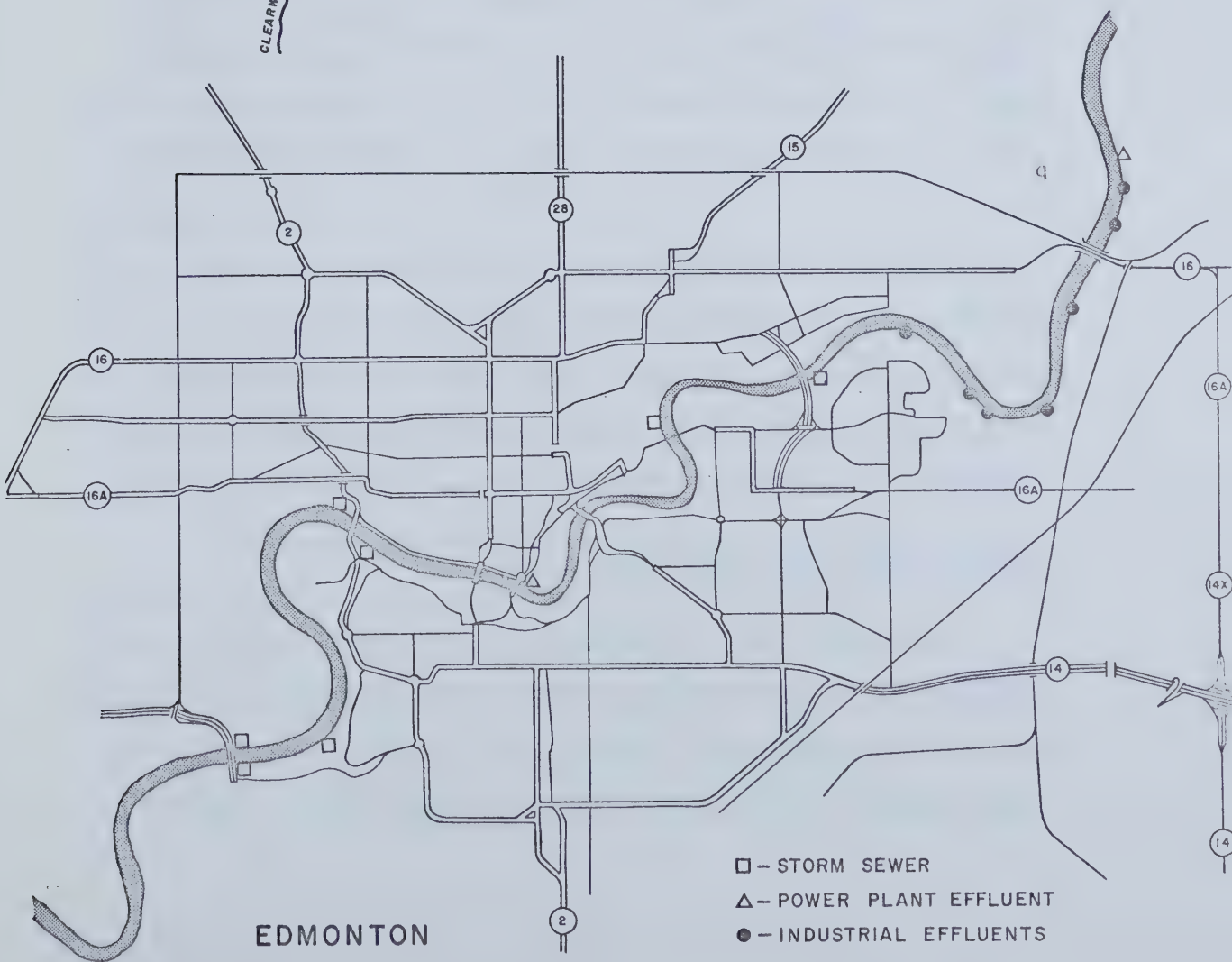
1. Brazeau Reservoir Discharge
2. Drayton Valley Bridge
3. Devon Bridge
4. 105 Street Bridge (Edmonton)
5. Fort Saskatchewan Bridge
6. Monitoring Station near Vinca Bridge
7. Waskatenau Bridge
8. Duvernay Bridge
10. Canadian Salt Company Water Intake
11. Lloydminster Ferry

HYDROMETRIC DATA

The discharge rate in the North Saskatchewan River at Edmonton



NORTH SASKATCHEWAN RIVER BASIN
WATER SAMPLING LOCATIONS



is influenced to a large extent by the operation of the hydro-electric generating station at Big Bend. This augmented flow from the Brazeau Reservoir during the winter has helped to alleviate some of the pollution problems in the North Saskatchewan River below Edmonton.

In the Fall of 1971, it was agreed between Calgary Power Limited and the Department of the Environment to change the operating schedule of the Big Bend Plant, to conserve as much water as possible during late Fall and early Winter for subsequent increased discharge during January, February and March. Past records indicated that the first three months of each year were the most critical period from the standpoint of water quality in the North Saskatchewan River.

The minimum average daily discharge in the Brazeau River below the Big Bend Plant during the past winter (November 1 to March 31) was 893 c.f.s. occurring on November 1, 1971. The minimum discharge during the first three months of 1972 was 1360 c.f.s. occurring on January 28, 1972.

Flows in the North Saskatchewan River at Edmonton dropped to a low of 1350 c.f.s. (December 18, 1971) during the winter. This low reading was the result of very cold weather and ice build-up in the river. Flows during the first three months of 1972 remained above 2000 c.f.s., the minimum for the period was 2020 c.f.s. (January 21, 1972).

LOADINGS TO THE NORTH SASKATCHEWAN RIVER

Major contributors of wastes to the river were surveyed in conjunction with the river quality surveys. These included four refineries, four chemical plants, one fibreboard plant, one fertilizer plant, one metal-fertilizer complex, and a sewage treatment plant. A complete

listing of the waste water dischargers and users of river water in the North Saskatchewan River basin is tabulated in the Appendix. The total loadings of various pollutants for each survey are also tabulated in the Appendix.

The following lists the minimum, mean, and maximum loadings of 8 constituents during four winter surveys:

<u>CONSTITUENT</u>	<u>LOADINGS (lbs/day)</u>		
	<u>Min.</u>	<u>Mean</u>	<u>Max.</u>
Biochemical Oxygen Demand (5-day, 20°C)	25,500	28,850	34,200
Chemical Oxygen Demand	46,400	81,050	134,500
Oil and Grease	2,790	3,300	4,150
Phenolics	11	19	33
Total Phosphorous	3,190	7,920	11,300
Ammonia Nitrogen	12,500	13,500	16,100
Nitrate Nitrogen	200	670	1,360
Hexavalent Chromium	5	20	39

DISSOLVED OXYGEN

Biological degradation of organic matter by bacteria results in an oxygen depression in our rivers, particularly during the winter when ice cover prevents re-aeration. Testing for dissolved oxygen at various locations in the river provides a means for assessing this rate of bio-degradation and provides an index for the performance of the river.

Dissolved Oxygen remained relatively high from the Brazeau River sampling location to Waskatenau Bridge. Minimum value in this portion of the river was 9.2 mg/l at Waskatenau Bridge on the survey of February 2, 1972. Dissolved Oxygen was further depressed at downstream locations. The lowest value observed during the winter was 6.7 mg/l at Lloydminster Ferry. Mean values during ice cover were 8.3 mg/l at Duvernay Bridge,

8.2 mg/l at Lindbergh, and 7.4 mg/l at Lloydminster Ferry.

BIOCHEMICAL OXYGEN DEMAND

Oxygen demand in surface water is exerted by three classes of material. Carbonaceous organic material available as food for micro-organisms, nitrogenous material susceptible to microbial oxidation, and chemical reducing agents such as ferrous iron, sulfates, sulfides of certain organic reducing agents. Biochemical Oxygen Demand indicates the oxygen demand potential in the aquatic environment and is used as a measure of organic pollution. It also indicates the rate at which bio-degradable organic material is being assimilated in the water.

Background values of Biochemical Oxygen Demand ranged from 0.2 mg/l to 2.0 mg/l. Both values were observed at the Brazeau Reservoir discharge location. Higher readings were observed downstream of Edmonton as expected. Maximum values were 3.2 mg/l at Fort Saskatchewan Bridge, 3.5 mg/l at Vinca Bridge, 2.2 mg/l at Duvernay Bridge, 2.0 mg/l at Lindbergh and 2.6 mg/l at Lloydminster Ferry. The general decreasing trend in Biochemical Oxygen Demand concentration from Waskatenau Bridge to Lloydminster Ferry is indicative of the biological degradation of organic substances in the river water.

NITROGEN COMPOUNDS

Nitrogen in surface waters may be present in many forms, including Ammonia, Nitrates, Nitrites, and Organic Nitrogen. Waters containing less than 10 mg/l of Nitrogen compounds are suitable for most beneficial uses although concentration above 0.3 mg/l may stimulate algae blooms provided other growth factors are present. Three of these compounds, Ammonia Nitrogen, and the combined Nitrate-Nitrite Nitrogen, were tested for in

the samples taken from the North Saskatchewan River.

The background values for Ammonia Nitrogen ranged from 0.1 mg/l to 0.6 mg/l. Downstream of Edmonton, the maximum value was 1.7 mg/l at Vinca Bridge (November 3, 1971) and Lindbergh (December 15, 1971). Concentration of Ammonia Nitrogen was considerably less this past winter than in the previous year.

Nitrate-Nitrite Nitrogen levels above Edmonton were at, or below 0.1 mg/l except for one sample taken at the Brazeau Dam discharge location. A concentration of 0.4 mg/l was determined on the sample taken on December 14, 1971. Generally higher values of Nitrate-Nitrite Nitrogen were observed downstream of Edmonton, reflecting the effects of wastes disposed to the river. The highest concentration measured was 1.1 mg/l at Waskatenau Bridge (March 1, 1972).

PHENOLS

Phenols are hydroxy derivatives of benzene found in waste products of oil refineries, coke plants, and other chemical producing facilities. It is found in mountain streams due to the decaying of vegetation and animal wastes. Chlorination of waters containing Phenols in the order of 1 ppb can impart objectionable taste to drinking water.

The test method for Phenols measures a whole series of organic compounds that are called "phenolics", yet it does not measure certain derivatives of the compounds, particularly those that are para-substituted with alkyl, aryl, nitro; benzoyl, nitroso or aldehyde groups.

Phenol concentration in the North Saskatchewan River varied between 0 ppb and 15 ppb. Except for the one high value determined at Devon Bridge (15 ppb), higher concentrations ranging from 0 to 10 ppb were observed downstream from Edmonton.

THRESHOLD ODOR NUMBER

Disagreeable taste and odors in water are associated with the presence of a great variety of objectionable substances. These may include microscopic organisms, decay products of vegetation, sewage and industrial waste products. Due to the large variety of substances capable of producing odor, it is sometimes impossible to isolate and identify the odor producing source.

The test method for determining odor is based on dilution of the sample with odor free water. Results are reported in terms of Threshold Odor Number, calculated from the amount of sample in the most diluted portion giving perceptible odor.

The Threshold Odor Number of samples taken from the North Saskatchewan River ranged from 1 to 4, except on two samples where values of 8 were determined. The two higher results were noted on November 3, 1971 at Vinca Bridge and Waskatenau Bridge locations.

OIL AND GREASE

Potential contributors of Oil and Grease in surface waters are all agencies engaged in the production, transportation, handling, and use of petroleum and petroleum products. In natural waters, the oily substance may be due to the decomposition of plankton or other aquatic life. Water flowing through an oil bearing strata would also add to the natural background level of Oil and Grease in the water.

The solvent extraction method used for determining Oil and Grease is dependent upon the solubility of the organics in the solvent and, consequently, on the solvent used. Light ends are lost in the removal of extraction solvent. This lost portion may represent a significant amount of the actual quantity of Oil and Grease in the sample.

Oil and Grease concentrations in the North Saskatchewan River were between 0.1 mg/l and 2.8 mg/l. Levels downstream of Edmonton were slightly higher than upstream values. The concentrations were generally slightly lower than values found in the past two years.

HEAVY METALS

Metals in surface waters are of serious concern, not only because of the possible toxic properties of these materials, but also because of the potential carcinogenicity. Some metals, such as Copper in trace amounts, are believed to be essential for nutrition, while others such as Mercury and Lead are cumulative poisons.

Three surveys for Metals were completed on the North Saskatchewan River during the past winter. Metals analyzed were Cadmium, Chromium, Cobalt, Copper, Manganese, Lead, Nickel, Selenium, Zinc and Mercury. Two samples from each of the ten locations were taken for Mercury analysis. Constituents which showed concentrations above established criteria levels were Selenium, Copper, Zinc and Mercury.

Concentration of Selenium exceeded Water Quality Criteria level of 10 ppb in four samples. The highest value was 30 ppb in a sample taken at the Brazeau Dam discharge location on February 29, 1972. The other three samples showed concentrations of 20 ppb.

Five samples exceeded Water Quality Criteria level of 20 ppb for Copper. The highest concentration was 435 ppb on the sample taken at Lloydminster Ferry on December 15, 1971. Other high readings were Lindbergh - 67 ppb and 32 ppb, Vinca Bridge - 65 ppb, and Drayton Valley - 325 ppb.

The Water Quality Criteria level for Zinc was exceeded in nine

samples. The highest concentration was 155 ppb at Brazeau Dam discharge location on February 29, 1972. Other high readings ranged from 62 ppb to 98 ppb.

Two sampling surveys were conducted for Mercury. High concentrations were found during the first survey (February 1-2, 1972) at eight of ten locations. The highest value was 2.9 ppb at Fort Saskatchewan Bridge. The high background level (1.9 ppb at Brazeau Dam discharge) would suggest contamination of samples taken during the survey, or some problem associated with the spectroscopy method of analysis.

BACTERIOLOGICAL CONSTITUENTS

Intestinal wastes from warm blooded animals regularly include a wide variety of bacteria species, including those of the coliform group. Analyses for the coliform group as a whole are used in official tests to comply with drinking water standards or with other standards which have been established for such use as recreation or agricultural application.

Values for the Most Probable Number (MPN) Total Coliform and MPN Faecal Coliform upstream of Edmonton were very similar to values observed in the previous year. There was no evidence of these constituents at the Brazeau Dam discharge location, but positive values were found from Drayton Valley Bridge to Edmonton. Maximum values determined were 1800 organisms/100 ml for MPN Total Coliform and 39 organisms/100 ml for MPN Faecal Coliform.

Downstream of Edmonton, higher values were found as expected with a maximum value of 7800 organisms/100 ml for MPN Total Coliform and 64 organisms/100 ml for MPN Faecal Coliform. General decreases in densities of these constituents were noted further downstream due to natural die-off.

EDMONTON STORM SEWERS

Surveys of storm sewers in Edmonton were conducted on three occasions during March. Samples were obtained from eight sewer outlets. Generally, the quality of the effluents were good. The maximum value for Threshold Odor Number was 500, the maximum for Oil and Grease was 32.7 mg/l, and maximum Phenols was 50 ppb. Metal analysis showed maximum value of 1,376 ppb for Manganese and 1,339 ppb for Lead.

SNOW DUMPS

Samples of snow from snow disposal sites were obtained in March. Ten locations were sampled during two surveys. Significant concentrations of Oil and Grease (maximum value 201.9 mg/l) were determined on these samples, as well as Lead (maximum value 5,153 ppb). The concentration of Benzo-a-Pyrene was below the detection limit of 1 ppb.

WATER POLLUTION CONTROL TECHNOLOGY

This is a selected list containing the key terms likely to be encountered in water pollution control technology.

ABSORPTION - The taking up of one substance into the body of another.

ACID - Most commonly refers to a large class of chemicals having a sour taste in water, ability to dissolve certain metals, bases or alkalies to form salts and to turn certain acid-base indicators to their acid form. Characterized by the hydrated H^+ ion.

ABSORPTION - The taking up of one substance upon the surface of or interface zone of another substance.

ADVANCED WASTE TREATMENT - Renovation of used water by biological, chemical or physical methods that are applied to upgrade water quality for specific reuse requirements. May include more efficient cleanup of a general nature or the removal of components that are inefficiently removed by conventional treatment processes.

AERATION - The operation of adding oxygen to, removing volatile constituents from, or mixing a liquid by intimate contact with air.

AEROBIC - A condition characterized by an excess of dissolved oxygen in the aquatic environment.

AEROBIC BACTERIA - Organisms that require dissolved oxygen in the aquatic environment to enable them to metabolize or to grow.

ALGAE - Primitive plants, one or many celled, usually aquatic and capable of growth on mineral materials via energy from the sun and the green coloring material, chlorophyll. Generally considered as the primary source of food for all other organisms.

ALKALINITY - A term used to represent the sum of the effects opposite in reaction to acids in water. Usually due to carbonates, bicarbonates and hydroxides; also including borates, silicates and phosphates.

ANAEROBIC - A condition in which dissolved oxygen is not detectable in the aquatic environment. Commonly characterized by the formation of reduced sulfur compounds from the use of bound oxygen from sulfates as a hydrogen acceptor.

ANAEROBIC BACTERIA - Organisms that can metabolize and grow in the absence of dissolved oxygen. Their oxygen supply is obtained from the bound oxygen such as in sulfates, carbonates, or other oxygen-containing compounds.

ANION - A negatively charged ion in water solution. May be a single element or a combination of elements, such as the Cl^- ion in a water solution of NaCl (common table salt) or $SO_4^{=}$ ion in a sulfuric acid solution.

- ASSESSMENT** - A legal financial obligation of the property owner in an irrigation, water, drainage or sanitary district, created for the purpose of financing the construction and operation of facilities required to protect and enhance public benefit within the district.
- BACTERIA** - Primitive organisms having some of the features of plants and animals. Generally included among the fungi. Usually do not contain chlorophyll, hence commonly require preformed organic nutrients among their foods. May exist as single cells, groups, filaments, or colonies.
- BENTHIC DEPOSIT (BENTHOS)** - Refers to the accumulated deposition of cell mass living or dead that collects at the bottom of a stream impoundment where velocity or catchment permits.
- BIO-CHEMICAL** - Resulting from the combined activities of biological and chemical transformations. Usually measured in terms of the ensuing chemical changes.
- BIODEGRADATION** - The stabilization of wastewater contaminants by biological conversion of pollutants into separatable materials at a higher oxidation state.
- BIOLOGICAL PROCESSES** - Activities of living organisms to sustain life, growth, and reproduction. Commonly the processes by which organisms degrade complex organic material into simpler substances at a higher oxidation state to obtain energy for life processes and growth of new cell mass.
- BOD** - Biological or biochemical oxygen demand. A test for estimation of wastewater polluting effects in terms of the oxygen requirements for biochemical stabilization under specified conditions and time.
- BUFFER ACTION** - An action exhibited by certain chemicals that limits the change in pH upon addition of acid or alkaline materials to the system. In surface water, the primary buffer action is related to carbon dioxide, bicarbonate and carbonate equilibria.
- CARBOHYDRATES** - Naturally occurring compounds consisting of carbon, hydrogen and oxygen, that are considered as energy foods and precursors of proteins and fats in the natural food chain.
- CATION** - A positively charged ion in water solution. May be a single element or a combination of elements, such as Na^+ in a water solution of NaCl (common table salt).
- CHLOROPHYLL** - The green coloring material or pigments in plants that promotes the photosynthetic reactions forming organic materials from inorganic nutrients and light energy within the living cells.
- CLARIFIER** - A basin or chamber serving as an enlargement of a channel to reduce flow velocity sufficiently to permit separation of settleable or floatable materials from the carrier water (a sedimentation basin).
- COAGULANT** - A chemical, or chemicals, which when added to water suspensions will cause finely dispersed materials to gather into larger masses of improved filterability, settleability, or drainability.

COAGULATION - The process of modifying chemical, physical, or biological conditions to cause flocculation or agglomeration of particulates.

COD - A test for the estimation of the contamination of a wastewater in terms of oxygen requirements from a strong chemical oxidant under specified conditions, i.e., Dichromate, 50% sulfuric acid and 145°C for 2 hours.

COLIFORM GROUP - A group of bacteria that inhabits the intestinal tract of man, warm-blooded animals, and may be found in plants, soil, air and the aquatic environment. Includes aerobic and facultative gram negative non-spore forming bacilli that ferment lactose with gas formation.

COLLOID, COLLOIDAL STATE - A state of suspension in which the particulate or insoluble material is in a finely divided form that remains dispersed in the liquid for extended time periods. Usually cloudy or turbid suspensions requiring flocculation before clarification.

CONCENTRATION -

- a) The act of increasing the mass per unit volume of one substance with respect to another, such as concentrating the solids in a sludge from 3% to 6%.
- b) A means of designating the ratio of one substance with respect to another, such as 15 mg of suspended solids per liter of water.

CRITERION (pl. CRITERIA) - Something which can be measured. Commonly used as a basis for standards.

CUBIC FOOT PER SECOND(c.f.s.) - A unit of discharge rate such as one cubic foot of water per second past a given point.

DATA - Records of observations or measurements of facts, occurrences and conditions in written, graphical or tabular form.

DEGRADE - To reduce the complexity of a chemical compound.

DENITRIFICATION -

- a) The conversion of oxidized nitrogen (nitrate and nitrite-N) to nitrogen gas by contact with septic wastewater solids or other reducing chemicals.
- b) A reduction process with respect to oxidized nitrogen.

DETERGENT - Something used for cleaning. Commonly consists of soap or surfactant plus various additives or associated materials.

DILUTION -

- a) To make thinner or more liquid.
- b) A ratio, volume or weight of a more concentrated sample or effluent flow compared to that into which it is discharged.

DISSOLVED -

- a) Those materials dispersed in water in ionic, atomic, or molecular form; an homogenous mixture or solution.
- b) Generally clear but may be colored
- c) Present in true solution form.

DISSOLVED OXYGEN (D.O.) - Dissolved molecular oxygen usually expressed in mg DO/l or percent of saturation.

ECOLOGY - The relation of an organism to its environment; i.e., how is an organism affected by its surroundings such as air, water, heat, noise, contamination, etc.

EFFLUENT - A liquid or product water discharged from a chamber, basin or other treatment operation.

ENTERIC ORGANISMS - Those organisms commonly associated with the intestinal tract.

ENTRAINMENT - A condition or action that will cause an immiscible substance to be mixed with another. Usually the result of turbulence or entrapment; i.e., air bubbles in aqueous media.

ENZYME - A soluble or colloidal organic catalyst produced by a living organism. Usually they are simple or conjugated proteins that catalyze specific reactions.

EUTROPHIC - Well nourished; rich in dissolved nutrients.

EUTROPHICATION - An action involving the aging of lakes characterized by nutrient enrichment and increasing growth of plant and animal organisms. The net effect is to decrease depth until the lake becomes a bog and eventually dry land. Man-made pollution tends to hasten the process.

FACULTATIVE BACTERIA - Bacteria that can adapt themselves to growth and metabolism under aerobic or anaerobic conditions. Many organisms of interest in wastewater stabilization are among this group.

FLOC - Gelatinous or amorphous solids formed by chemical, biological or physical agglomeration of fine materials into larger masses that are more readily separated from the liquid.

FUNGI - Simple or complex organisms without chlorophyll. The simpler forms are one-celled; higher forms have branched filaments and complicated life cycles. Examples are molds, yeasts and mushrooms.

HARDNESS - Commonly refers to the chemicals interfering with soap action or producing scale in boilers or heating units. Specifically refers to Calcium and Magnesium salts; sometimes including iron, aluminum, and silica.

INDICATOR - May include the color change of a dye, electronic sensor response, or other means of estimating the equivalence point of a reaction between two different materials.

INFLUENT - That material entering a process unit or operation.

INORGANIC - Being composed of material other than plant or animal materials. Forming or belonging to the inanimate world.

LAGOON - A natural or artificial basin used for storage and/or stabilization of wastewater or sludge. Sometimes used for indefinite storage for disposal purposes. Commonly the lagoon depth is greater than a wadable depth but not greater than twenty feet.

LOAD - The load to a process is that which is contained in the inflow to that process. It may be expressed as hydraulic, oxygen demand, solids, or other criteria.

MICRO ORGANISMS - Commonly an organism too small to be observed individually by the human eye without optical aid.

MG/L - A unit of concentration on a weight/volume basis: Milligrams per liter. Equivalent to ppm when the specific gravity of the liquid is 1.0.

MIXING ZONE - An area where two or more substances of different characteristics blend to form a uniform mixture; i.e., chlorine application, heated water, or other discharged materials entering a water mass will show significant differences or chlorine residual, temperature or other criteria, depending upon the sampling location throughout the mixing zone and approach uniform results with respect to lateral, longitudinal, and vertical sampling positions when mixing has been completed.

MOST PROBABLE NUMBER (MPN) - A statistical method of determining microbial populations. A multiple dilution tube technique is utilized with a standard medium and observations are made for specific individual tube effects. Resultant coding is translated by mathematical probability tables into population numbers.

NITRIFICATION - The biochemical conversion of unoxidized nitrogen (ammonia and organic N) to oxidized nitrogen (usually nitrate).

NUTRIENTS -

- a) Anything essential to support life.
- b) Includes many common elements and combinations of them. The major nutrients include carbon, hydrogen, oxygen, nitrogen, sulfur, and phosphorous.
- c) Nitrogen and phosphorous are of major concern because they tend to recycle and are hard to control.

OILS -

- a) Liquid fats of animal or vegetable origin.
- b) Oily or waxy mineral oils.

OXIDATION POND - A shallow basin employed for the stabilization of wastewaters.

OXYGEN DEPLETION - The loss of oxygen from water or sewage due to biological, chemical or physical action.

PARASITE - A living organism deriving its nutrients at the expense of another living organism, giving nothing in return.

PARSHALL FLUME - A device for estimation of the flow in an open conduit. Consists of a constricting section, a throat, and an expanding section. The throat contains a sill over which the liquid passes. The pressure change over the sill can be related to quantity of flow.

PARTS PER MILLION (PPM) - A unit of concentration signifying parts of some substance per million parts of dispersing medium. Equivalent numerically to mg/l only when the specific gravity of the solution is 1.0.

PATHOGENIC ORGANISMS - Bacterial, fungal, viral, or other organisms directly involved with diseases of plants, animals, or man, are included among this group.

pH - An index of hydrogen ion activity. Defined as the negative logarithm (base 10) of H^+ ion concentration at a given instant. On a scale of 0 to 14 pH 7.0 is neutral, pH less than 7.0 indicates a predominance of H^+ or acid ions; pH greater than 7.0 indicates a predominance of OH^- or alkaline ions.

POLLUTION - Anything appearing in water that renders it unacceptable in terms of established water quality standards. Commonly conditions or contaminants that interfere with subsequent beneficial uses of the water.

PRIMARY TREATMENT - Commonly the separation of settleable or floatable materials from carrier water. Usually preceded by pretreatment such as coarse screens, grit separation, comminution.

SATURATION - Commonly refers to the maximum amount of any material that can be dissolved in water or other liquid at a given temperature and pressure. For oxygen, this commonly refers to a percentage saturation in terms of the saturation value, such as about 9 mg O_2 /l at 20°C.

SECOND FOOT - An abbreviation for cubic foot per second. A rate term.

SECONDARY TREATMENT - Processes used to convert dissolved and colloidal materials in wastewater to a form that may be separated from the water. Commonly consists of biodegradation and conversion to cell mass in a separatable form with partial oxidation, such as in activated sludge, trickling filtration, or oxidation ponds.

SETTLEABLE SOLIDS -

- a) Includes materials that will settle by gravity under low flow velocities.
- b) Commonly expressed in terms of the volume of solids accumulating in an Imhoff cone after one hour on a volume basis.

SEWER - A pipe or conduit, generally covered, for the purposes of conveying wastewaters from the point of origin to a point of treatment or discharge.

SEWERAGE SYSTEM - A system of sewers and appurtenances for the collection, transportation and pumping of used waters for a given area or basin. Any treatment device or facility and its outfall conduit are a part of the system.

SLIME - SEWAGE SLIMES - Consisting of organisms growing on wastewaters nutrients with the formation of mucilaginous covering, streamers or clumps. May consist of bacteria, molds, protozoa or algae.

STABILIZATION -

- a) The activity proceeding along the pathway to stability.
- b) In organic wastes, generally refers to oxidation via biochemical pathways and conversion to gaseous or insoluble materials relatively inert to further change.

STANDARD - Something set by authority. Having qualities or attributes required by law and defined by minimum or maximum limits of acceptability in terms of established criteria or measurable indices.

STANDARD METHODS - Methods of analysis prescribed by joint action of APHA, ASCE, AWWA, and FWPCA. Methods accepted by authority.

SUBSTRATE -

- a) The base or media in which an organism lives.
- b) The liquid in an activated sludge aeration tank.

SURFACTANT -

- a) A chemical that, when added to water, will greatly reduce the surface tension of the solution.
- b) The surface active component in a detergent mixture.

SUSPENDED SOLIDS - The concentration of insoluble materials suspended or dispersed in waste or used water. Generally expressed in mg/liter on a dry weight basis. Usually determined by filtration methods.

SYNERGISM - Refers to the action produced when two or more substances in combination have a greater effect than that produced by the additive effects of each one separately.

THERMAL POLLUTION - Refers to heated discharges to surface waterways. The largest contributor of heated discharges is associated with power production.

TOC - Total Organic Carbon. A test expressing wastewater contaminant concentration in terms of the carbon content.

TOTAL SOLIDS - Refers to the solids contained in dissolved and suspended form in water. Commonly determined on a weight basis by evaporation to dryness.

VELOCITY(FLOW) - A rate term expressed in terms of linear movement per unit of time. Commonly expressed in ft per sec (English) or cm/sec (Metric).

VOLATILE MATERIAL -

- a) Refers to those chemicals having a vapor pressure low enough to evaporate from water readily at normal temperatures.
- b) With reference to dry solids, the term includes loss in weight upon ignition at 600°C.

WATER QUALITY CRITERIA - Includes selected analytical measurements with limits designated to be acceptable or unacceptable in reference to water quality standards.

WATER QUALITY STANDARDS - Limits set by authority on the basis of water quality criteria required for beneficial uses.

WASTEWATER - Refers to the used water of a community. Generally contaminated by the waste products from household, commercial or industrial activities. Often contains surface wash, storm water and infiltrations water.

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APPENDIX B

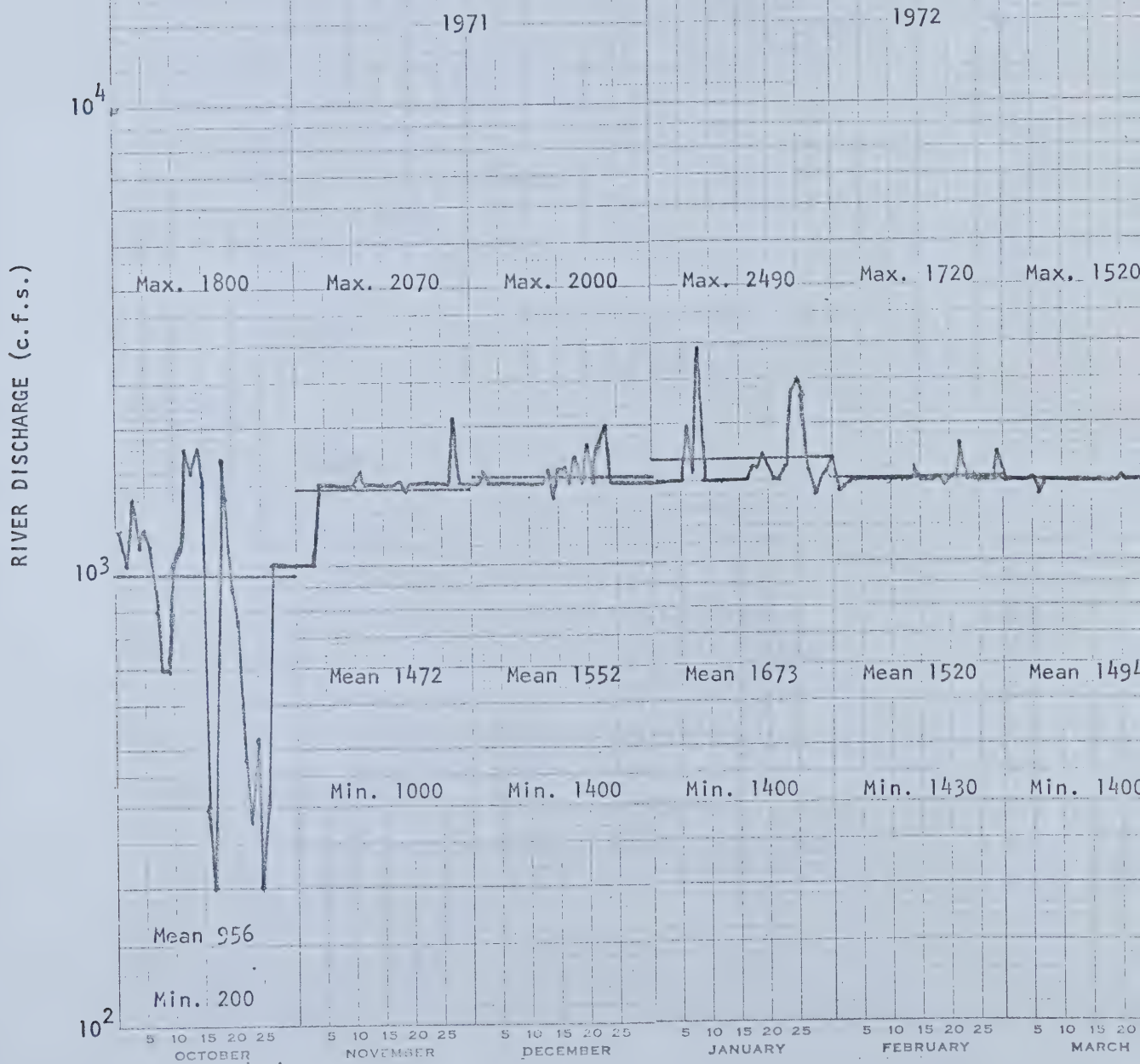
ANALYTICAL DATA

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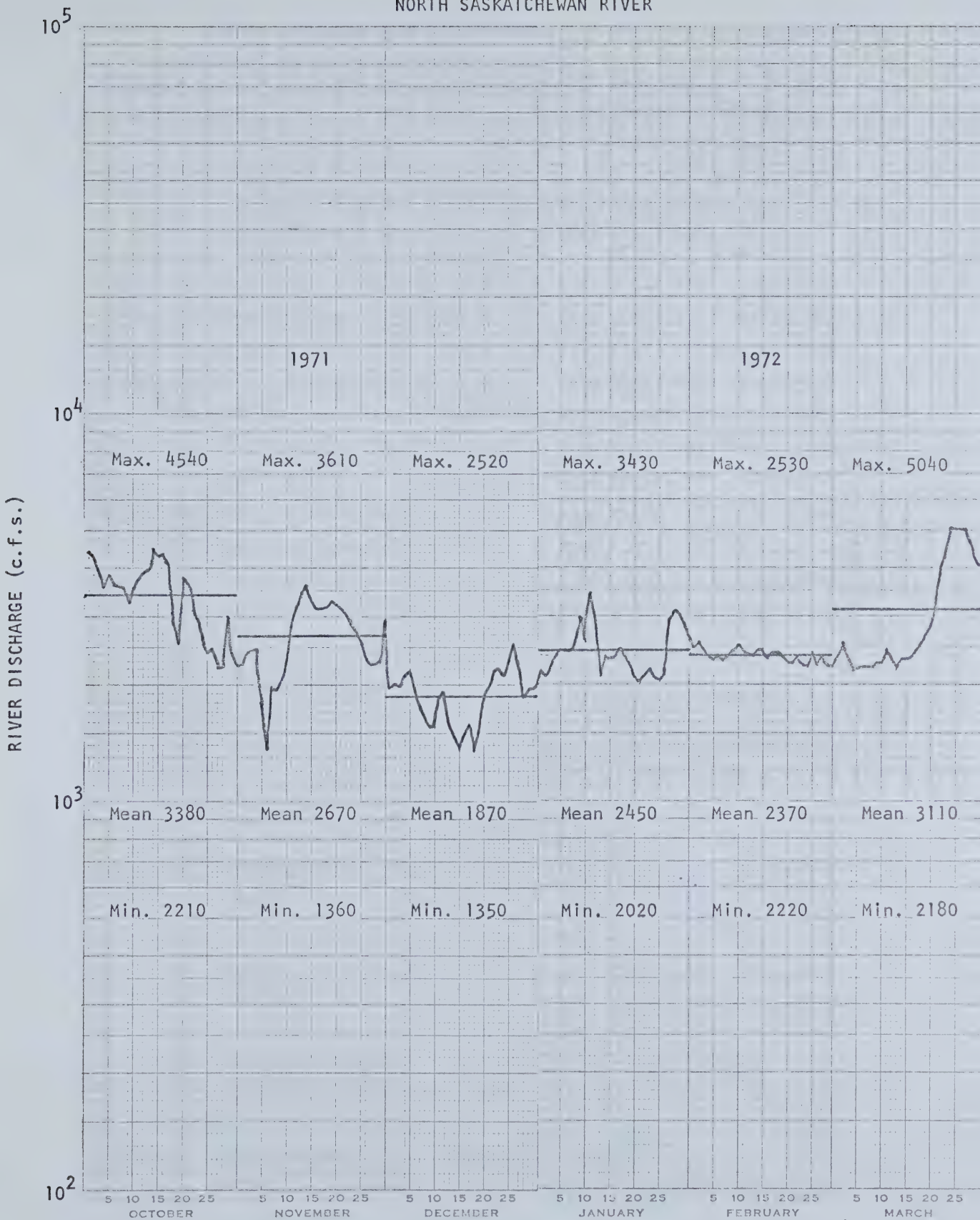
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APPENDIX A

BRAZEAU RIVER DAILY FLOW RATES AT BRAZEAU DAM DISCHARGE



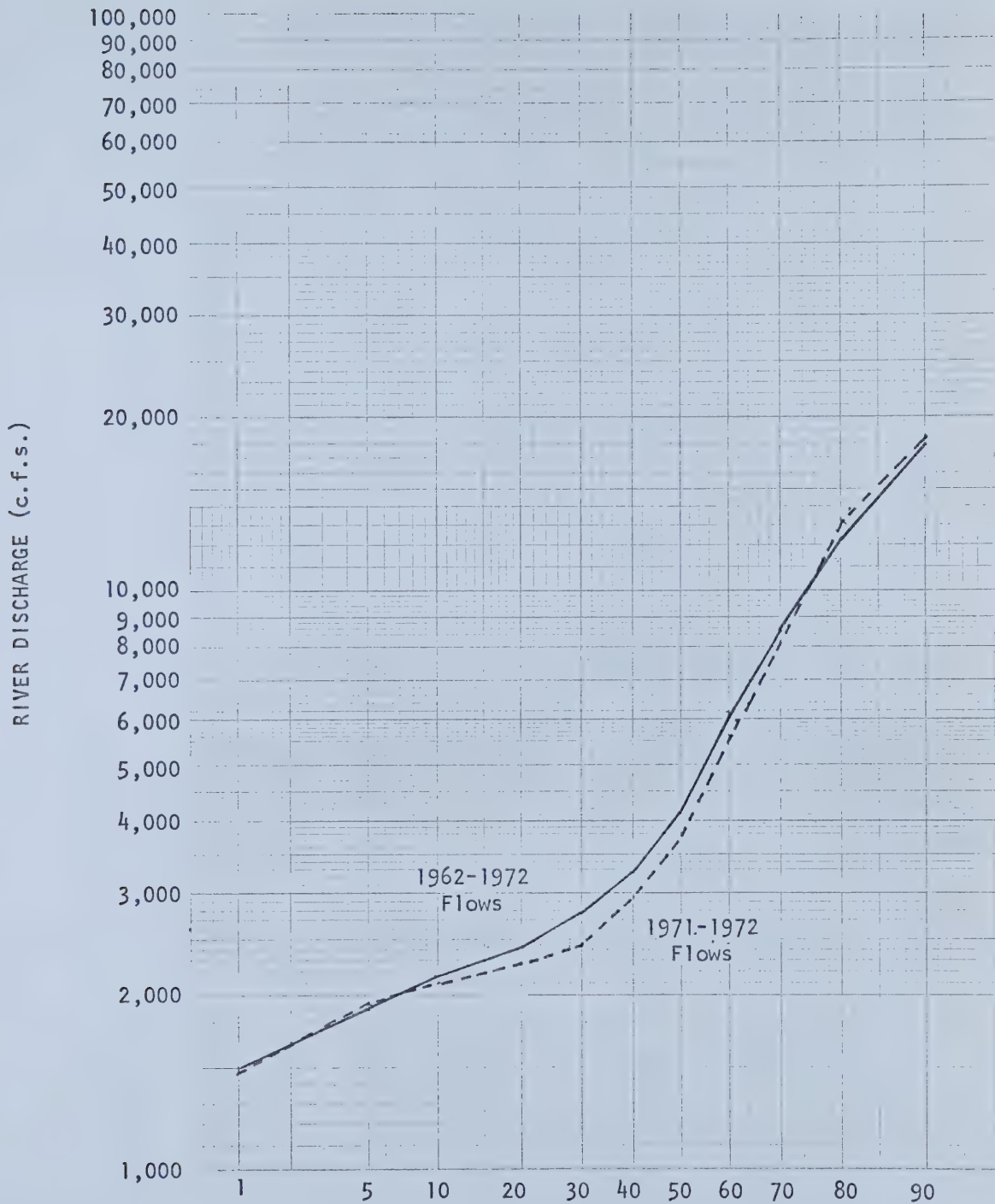
NORTH SASKATCHEWAN RIVER



DAILY FLOW RATES AT 105 ST. BRIDGE

STATION NO. 05DF001

STATISTICAL FLOW ANALYSIS OF THE NORTH SASKATCHEWAN RIVER AT EDMONTON



FREQUENCY OF OCCURRENCE LESS THAN INDICATED (Per Cent)

1962 - March 1972

Maximum Flow - 91,600 cubic feet per second
Minimum Flow - 1,070 " " " "

April 1971 - March 1972

Maximum Flow - 41,700 " " " "
Minimum Flow - 1,350 " " " "

STATISTICAL FLOW ANALYSIS FOR THE NORTH SASKATCHEWAN RIVER AT EDMONTON

1962 - March 1972

THERE ARE 3470 PIECES OF DATA

THE MINIMUM FLOW IS 1070 CUBIC FEET PER SECOND

1% OF THE TIME THE FLOW IS LESS THAN	1500 CUBIC FEET PER SECOND
5% OF THE TIME THE FLOW IS LESS THAN	1900 CUBIC FEET PER SECOND
10% OF THE TIME THE FLOW IS LESS THAN	2160 CUBIC FEET PER SECOND
20% OF THE TIME THE FLOW IS LESS THAN	2420 CUBIC FEET PER SECOND
30% OF THE TIME THE FLOW IS LESS THAN	2760 CUBIC FEET PER SECOND
40% OF THE TIME THE FLOW IS LESS THAN	3290 CUBIC FEET PER SECOND
50% OF THE TIME THE FLOW IS LESS THAN	4120 CUBIC FEET PER SECOND
60% OF THE TIME THE FLOW IS LESS THAN	6090 CUBIC FEET PER SECOND
70% OF THE TIME THE FLOW IS LESS THAN	8550 CUBIC FEET PER SECOND
80% OF THE TIME THE FLOW IS LESS THAN	12200 CUBIC FEET PER SECOND
90% OF THE TIME THE FLOW IS LESS THAN	17900 CUBIC FEET PER SECOND

THE MAXIMUM FLOW IS 91600 CUBIC FEET PER SECOND

APRIL 1971 - MARCH 1972

THERE ARE 366 PIECES OF DATA

THE MINIMUM FLOW IS 1350 CUBIC FEET PER SECOND

1% OF THE TIME THE FLOW IS LESS THAN	1470 CUBIC FEET PER SECOND
5% OF THE TIME THE FLOW IS LESS THAN	1930 CUBIC FEET PER SECOND
10% OF THE TIME THE FLOW IS LESS THAN	2100 CUBIC FEET PER SECOND
20% OF THE TIME THE FLOW IS LESS THAN	2280 CUBIC FEET PER SECOND
30% OF THE TIME THE FLOW IS LESS THAN	2450 CUBIC FEET PER SECOND
40% OF THE TIME THE FLOW IS LESS THAN	2950 CUBIC FEET PER SECOND
50% OF THE TIME THE FLOW IS LESS THAN	3790 CUBIC FEET PER SECOND
60% OF THE TIME THE FLOW IS LESS THAN	5590 CUBIC FEET PER SECOND
70% OF THE TIME THE FLOW IS LESS THAN	8070 CUBIC FEET PER SECOND
80% OF THE TIME THE FLOW IS LESS THAN	13100 CUBIC FEET PER SECOND
90% OF THE TIME THE FLOW IS LESS THAN	18300 CUBIC FEET PER SECOND

THE MAXIMUM FLOW IS 41700 CUBIC FEET PER SECOND

NORTH SASKATCHEWAN EFFLUENT DISCHARGERS

<u>Source</u>	<u>Type of Discharge and Treatment</u>
Town of Rocky Mountain House	Domestic Sewage (L)
Town of Drayton Valley	Domestic Sewage (L)
Town of Devon	Domestic Sewage (ST)
Imperial Oil - Devon	Industrial (L)
City of Edmonton	Domestic Sewage (ST in Winter)
Canadian Industries Ltd.	Industrial Waste (WELL)
Building Products Ltd.	Industrial Waste (AERATED LAGOONS)
Imperial Oil Ltd.	Industrial Waste (AERATED LAGOONS)
Texaco Canada Limited	Industrial Waste (A.P.I., WELL, L)
Union Carbide Canada Ltd.	Industrial Waste (L)
Turbo Oil Limited	Industrial Waste (L)
Gulf Oil Canada Limited	Industrial Waste (A.P.I., L)
Celanese Canada Limited	Industrial Waste (WELL, L)
Uniroyal	Industrial Waste (L - Summer Discharge)
Alberta Hospital - Oliver	Waste Storage & Disposal during Summer Months (L) to City Lagoons
City of Edmonton Packing Plants	
Sherwood Park	
Town of Fort Saskatchewan	Domestic Sewage (L)
Sherritt Gordon Mines Ltd.	Industrial Waste (L)
Dow Chemical Limited	Industrial Waste (L, WELL)
Redwater Imperial Fertilizer	Industrial Waste (L)
Redwater Imperial Oil Gas Plant	Industrial Waste (L)
Celanese Canada Ltd. - Duvernay	Industrial Waste (NT)
Elk Point	Domestic Sewage (L)
Canadian Salt Co. Ltd.	Industrial Waste (NT)

LEGEND:

L - Lagoon

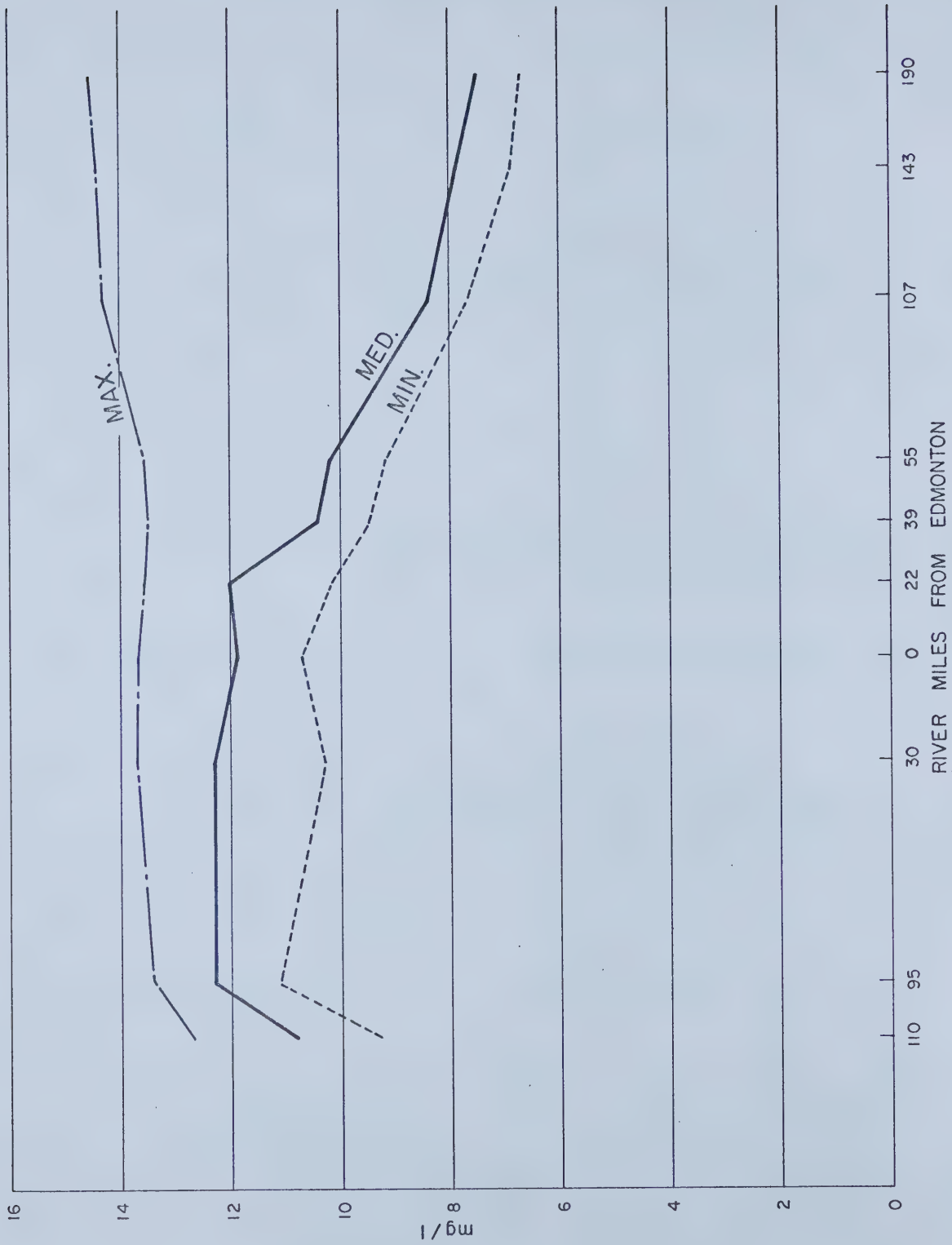
ST - Secondary Treatment

NT - No Treatment

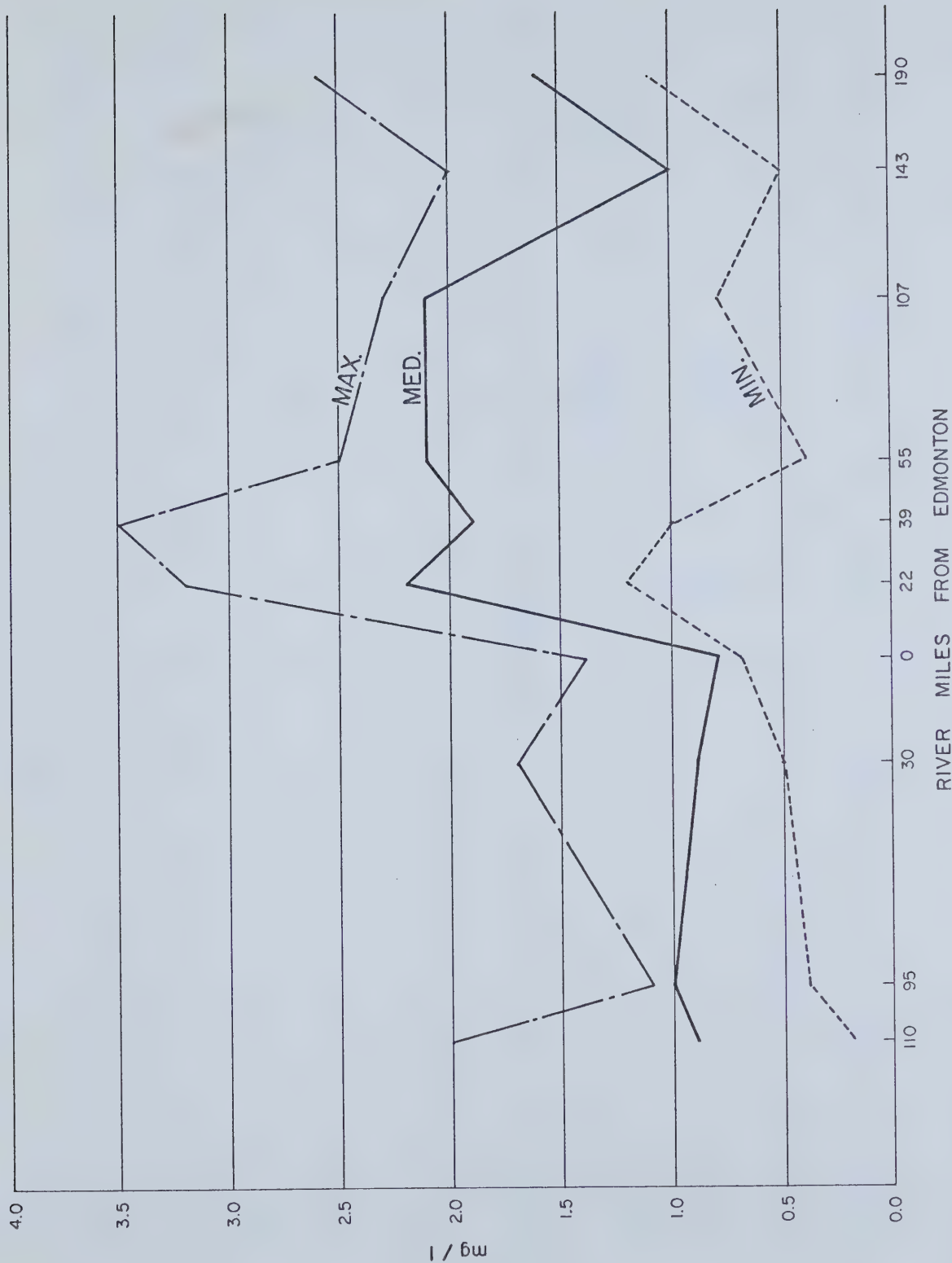
API - A.P.I. Separator

TOTAL LOADINGS TO THE NORTH SASKATCHEWAN RIVER IN LBS/DAY

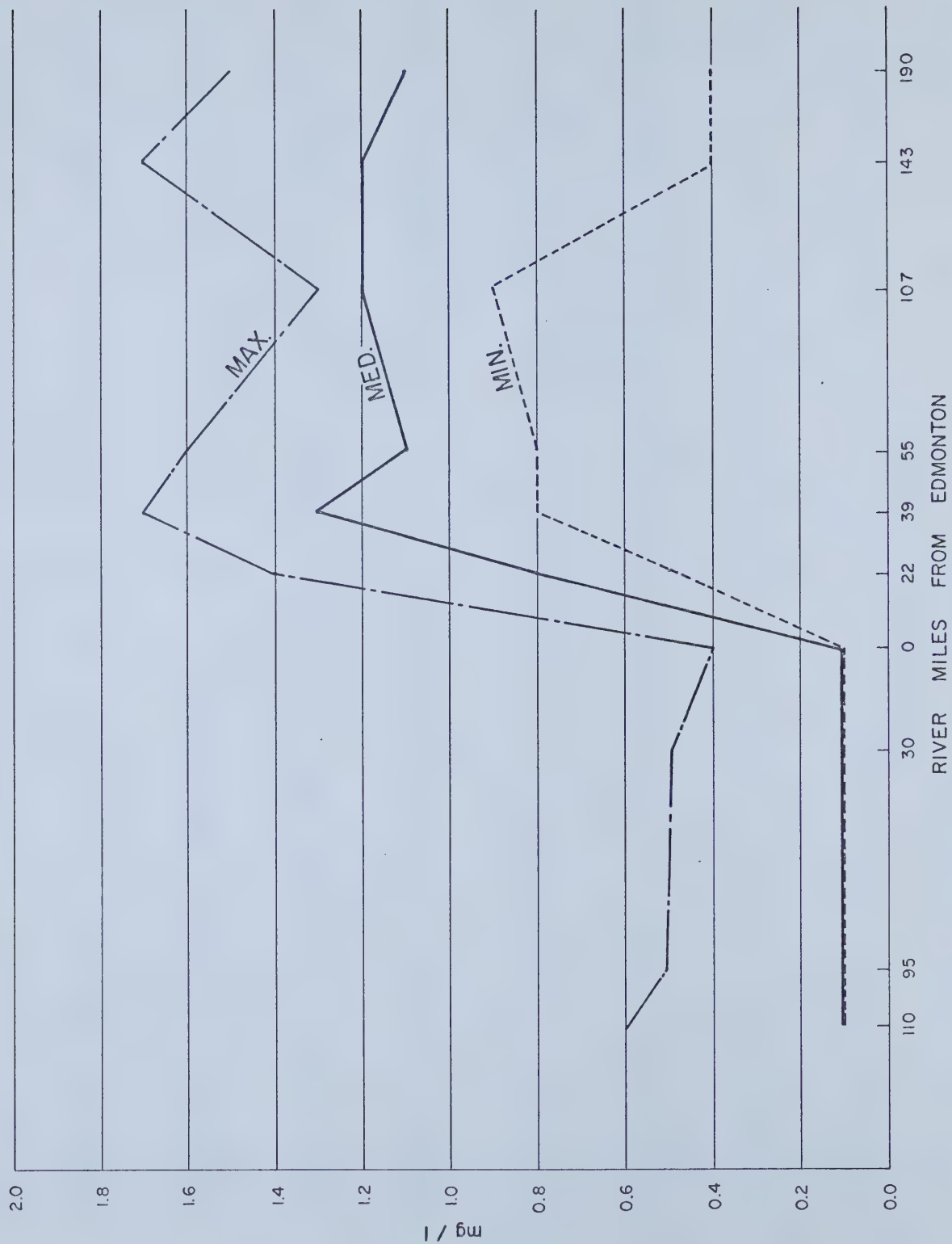
<u>PARAMETER</u>	<u>Nov. 1-2/71</u>	<u>Dec. 14-15/71</u>	<u>Jan. 10-12/72</u>	<u>Jan. 30-Feb. 3/72</u>
Biochemical Oxygen Demand	26,800	34,200	25,500	28,900
Chemical Oxygen Demand	68,300	134,500	46,400	75,000
Alkalinity pp as CaCO ₃	25,300	14,100	35,500	11,100
Total Alkalinity as CaCO ₃	141,000	114,000	135,300	134,700
Total Residue	1,387,000	862,000	756,100	977,300
Ignition Loss	124,500	76,600	90,800	115,600
Nonfilterable Residue	21,100	27,300	32,300	66,400
Ignition Loss	10,900	20,100	10,500	39,700
Oil & Grease	3,140	2,790	4,150	3,110
Phenols	11	33	20	11
Total Phosphorous as PO ₄	8,310	8,880	11,300	3,190
Ammonia Nitrogen	12,700	12,500	16,100	12,700
Nitrate Nitrogen	1,360	700	430	200
Chlorides	782,900	231,400	315,600	443,900
Sulphates	28,600	18,900	100,900	95,000
Hexavalent Chromium	5	9	39	29
Fluorides	18	24	7	17



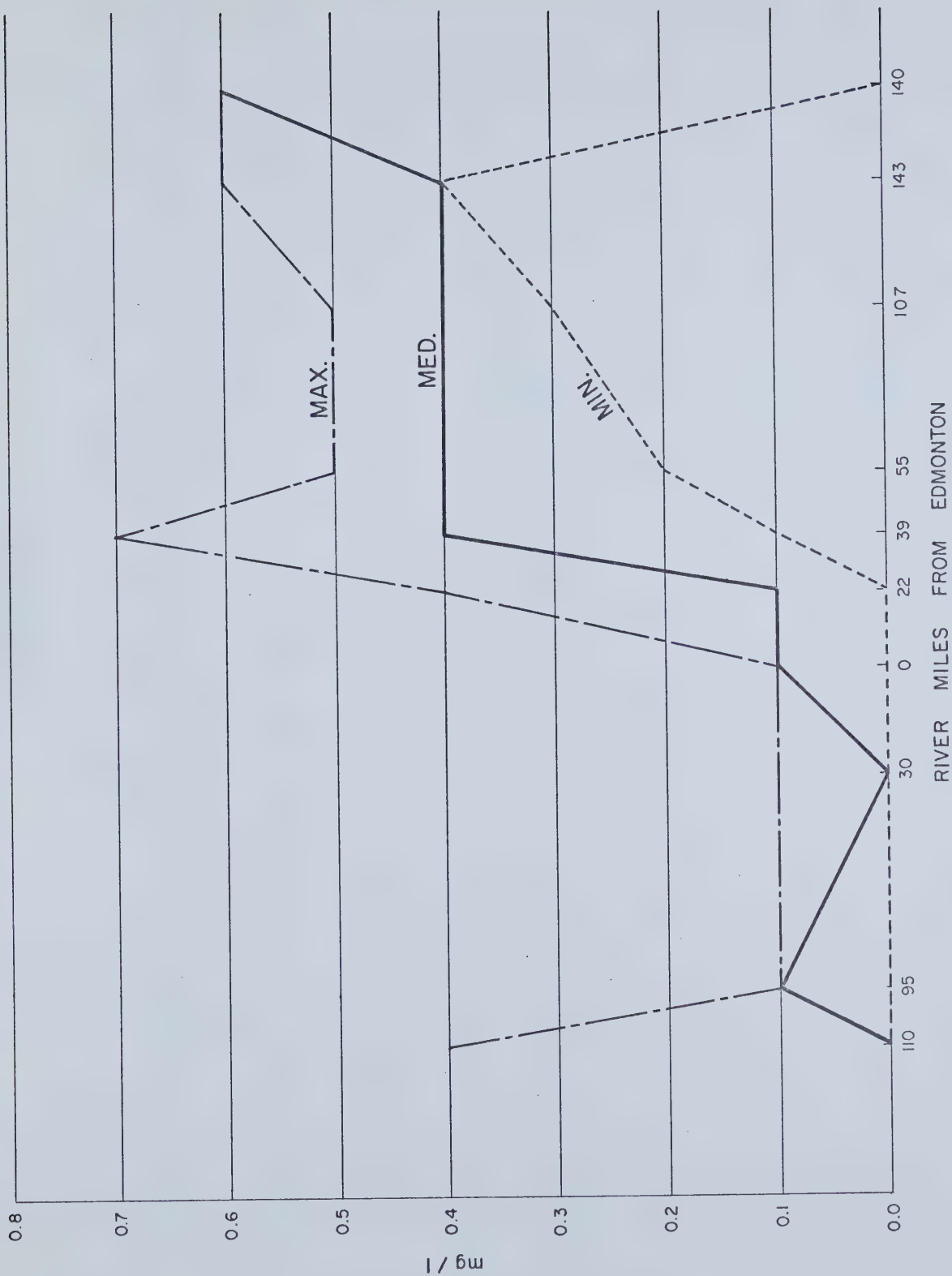
DISSOLVED OXYGEN
NORTH SASKATCHEWAN RIVER



BIOCHEMICAL OXYGEN DEMAND
NORTH SASKATCHEWAN RIVER
1971 - 72 SURVEY



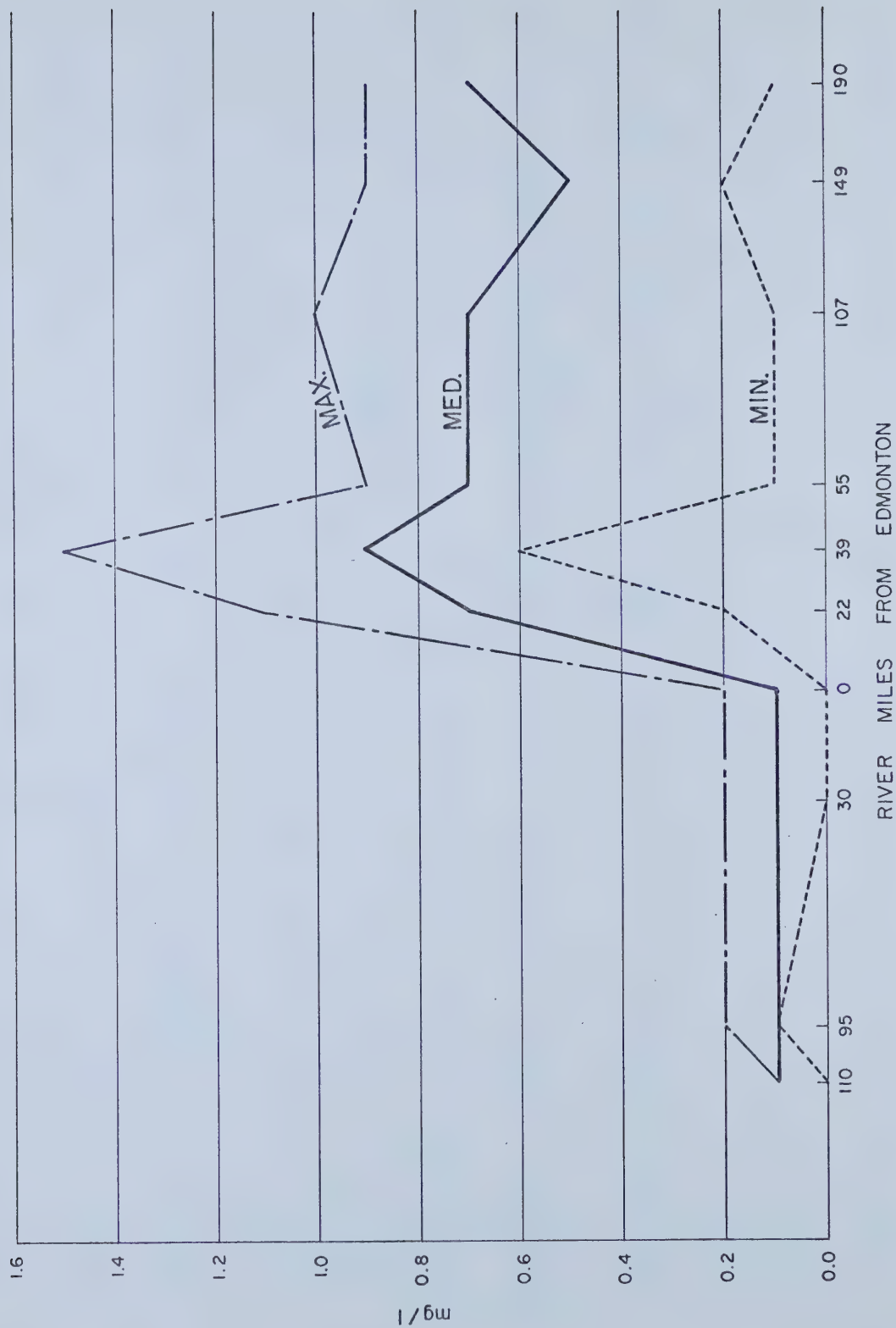
AMMONIA - NITROGEN
NORTH SASKATCHEWAN RIVER
1971-72 SURVEY



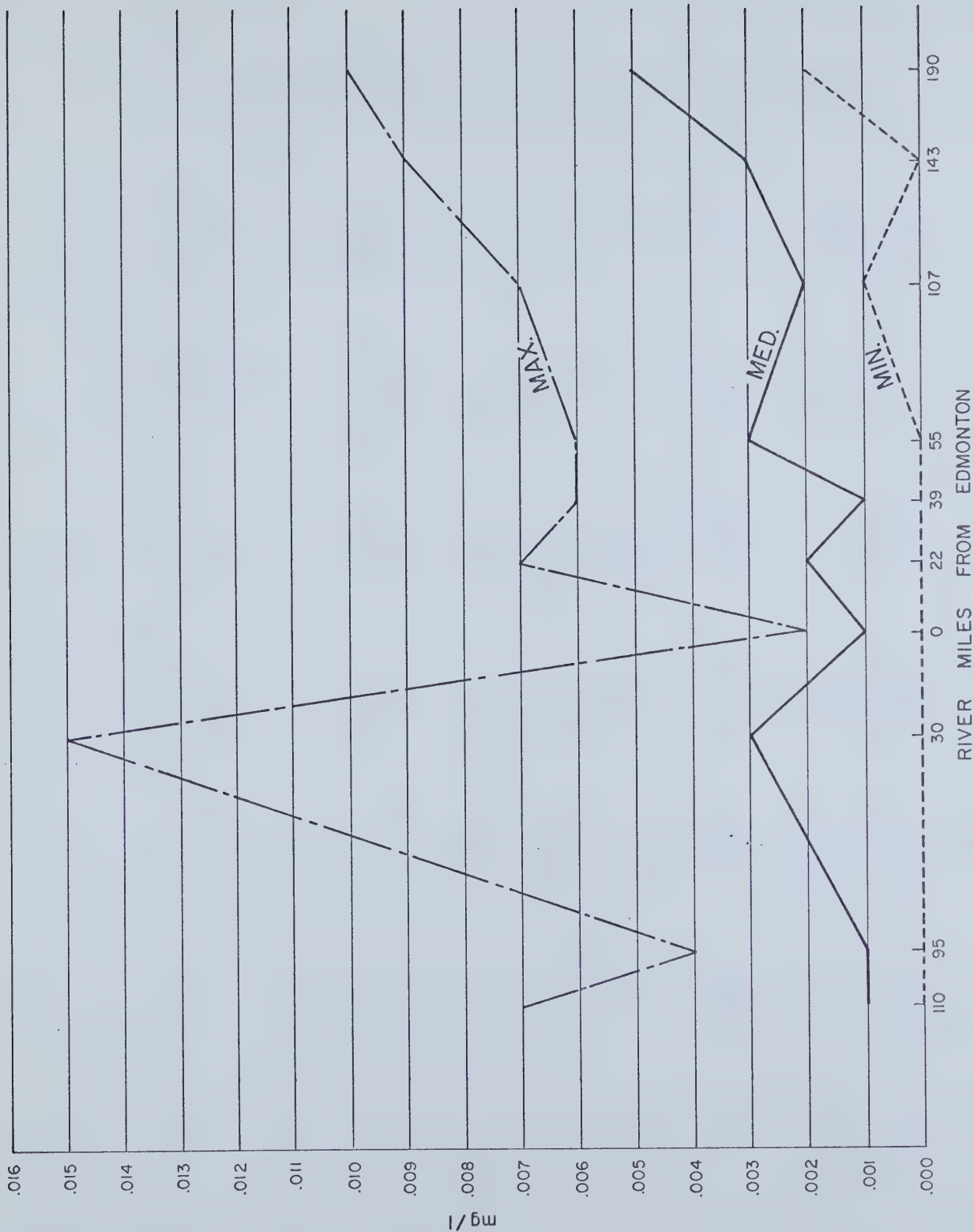
NITRATE AND NITRITE NITROGEN

NORTH SASKATCHEWAN RIVER

1971 - 72 SURVEY



PHOSPHATES
NORTH SASKATCHEWAN RIVER
1971 - 72 SURVEY



PHENOLS
NORTH SASKATCHEWAN RIVER
1971 - 72 SURVEY

APPENDIX B

WATER QUALITY DATA

NORTH-SASKATCHEWAN RIVER DATA

STATION 00AT05DD2050 LATITUDE 52D 54M 45S LONGITUDE 115D 21M 20S

BRAZEAU RIVER AT
BRAZEAU DAM DISCHARGE

SAMPLE TIME			10101L		10151L		16302L		11101L		20101L		08101L		08202L	
DATE			SPECIFIC CONDUCTANCE		ALKALINITY PHENOL		SULPHATE DISSOLVED		SODIUM DISSOLVED		CALCIUM DISSOLVED		OXYGEN DISSOLVED		OXYGEN DEMAND	
MST			CACO3 MG/L		CACO3 MG/L		SO4 MG/L		NA MG/L		CA MG/L		O2 MG/L		BIOCHEMICAL	
D	M	Y	H	M	UMHO/CM											
2	11	71	11	30			35.0		7.0				12.7		0.9	
14	12	71	11	00					3.0				10.0		0.7	
11	1	72	12	15	180		50.0		3.0		45.0		10.8		2.0	
1	2	72	12	00	135		40.0				45.0		9.3		1.0	
29	2	72	13	45	135		45.0		3.0		42.0		11.9		0.2	

SAMPLE TIME			10301L		17201L		26103L		07106L		07551L		15406L		19101L	
DATE			PH		CHLORIDE DISSOLVED		IRON DISSOLVED		NITROGEN DISS. NITRATE & NITRITE		NITROGEN DISSOLVED AMMONIA		PHOSPHOROUS TOTAL PHOSPHATE		POTASSIUM DISSOLVED	
MST			TURBIDITY UNITS		CL MG/L		FE MG/L		N MG/L		N MG/L		P MG/L		K MG/L	
D	M	Y	H	M												
2	11	71	11	30	8.1				0.0		0.1		0.1		1.0	
14	12	71	11	00	8.0	4.0			0.4		0.2		0.1		0.6	
11	1	72	12	15	7.9	L1.0	L1.0		L1.0		0.1		0.1		0.9	
1	2	72	12	00	7.7	2.0			L1.0		0.6		0.0		1.0	
29	2	72	13	45	7.9	0.4			0.1		0.1		0.1			

B

SAMPLE TIME			02001L		06521L		10471L		36001L		36011L		36900L		02061F	
DATE			ODOUR		PHENOLIC MATERIAL		RESIDUE TOTAL		COLIFORM TOTAL		COLIFORM FECAL		STANDARD PLATE COUNT		TEMPERATURE	
MST			THRESHOLD ODOUR NUMBER		O & G MG/L		MG/L		MPN		MPN		NO/ML		DEG.C.	
D	M	Y	H	M												
2	11	71	11	30	4	0.000	0.7	182.0	0		0		9000		1	
14	12	71	11	00	1	0.000	0.7	216.0	0		0		1		0	
11	1	72	12	15	2	0.005	0.5	270.0	0		0		10		0	
1	2	72	12	00	4	0.001	2.2	240.0	0		0		1		0	
29	2	72	13	45	2	0.007		225.0	0		0		1		0	

SAMPLE TIME			48004L		10605L		09105L		27004L		29008L		57161F	
DATE			CADMIUM TOTAL		HARDNESS TOTAL		FLUORIDE DISSOLVED		COBALT TOTAL		COPPER TOTAL		FLOW AVERAGE (DAILY) PROVISIONAL CU.F.T/SEC	
MST			CD MG/L		CACO3		F MG/L		CO MG/L		CU MG/L			
D	M	Y	H	M										
2	11	71	11	30	0.001	150.0			0.003		0.005		1000	
14	12	71	11	00		200.0	0.002						1400	
11	1	72	12	15		180.0							1500	
1	2	72	12	00	0.001	200.0	0.005		0.004		0.001		1430	
29	2	72	13	45	0.001	180.0	0.002	0.10	0.004		0.008		1500	

SAMPLE TIME			82005L		25008L		34003L		30006L		80002L	
DATE			LEAD TOTAL		MANGANESE TOTAL		SELENIUM TOTAL		ZINC TOTAL		MERCURY TOTAL	
MST			Pb MG/L		Mn MG/L		Se MG/L		Zn MG/L		Hg MG/L	
D	M	Y	H	M								
14	12	71	11	00	0.01	0.03			0.011			
1	2	72	12	00	0.01	0.01	0.02		0.049		0.0019	
29	2	72	13	45	0.01	0.02	0.03		0.155		0.0005	

WATER QUALITY DATA

STATION COAT05DE2060										LATITUDE 53D 12M 40S LONGITUDE 114D 55M 30S									
NORTH SASKATCHEWAN RIVER AT DRAYTON VALLEY BRIDGE																			
SAMPLE DATE		TIME		02041L SPECIFIC CONDUCTANCE		10101L ALKALINITY TOTAL		10151L ALKALINITY PHENOL		16302L SULPHATE DISSOLVED		20101L CALCIUM DISSOLVED		08101L OXYGEN DISSOLVED		08202L OXYGEN BIOCHEMICAL DEMAND			
D	M	Y	H	M	UMHO/CM	CAC03	MG/L	CAC03	MG/L	SO4	MG/L	CA	MG/L	O2	MG/L	O2	MG/L		
2	11	71	13	00						55.0		6.0		13.4		0.4			
14	12	71	13	30						75.0		4.0		13.2		1.1			
11	1	72	11	00	380	155				65.0		45.0		12.3		1.0			
1	2	72	10	45	340	160				60.0		38.0		11.1		0.6			
29	2	72	12	00										11.8		1.0			
SAMPLE DATE		TIME		02073L TURBIDITY TOTAL		10301L PH		17201L CHLORIDE DISSOLVED		20103L IRON DISSOLVED FE+2 + FE+3		07106L NITROGEN DISSOLVED NITROGEN & NITRITE		15406L PHOSPHOROUS TOTAL PHOSPHATE P		19101L POTASSIUM DISSOLVED			
D	M	Y	H	M	UNITS	PH UNITS	MG/L	CL	MG/L	FE	MG/L	N	MG/L	P	MG/L	K	MG/L		
2	11	71	13	00	1.0	8.1						0.1		0.1		1.0			
14	12	71	13	30	2.0	8.1		2.0				0.1		0.1		0.9			
11	1	72	11	00	1.0	7.9		11.0		L.1		0.1		0.1		0.9			
1	2	72	10	45	15.0	8.3		12.0		L.1		0.1		0.0		0.9			
29	2	72	12	00	0.4			0.5				0.1		0.2					
SAMPLE DATE		TIME		02001L ODOUR		06531L PHENOLIC MATERIAL		06521L OIL & GREASE		10471L RESIDUE TOTAL		36001L COLIFORM FECA		36900L STANDARD PLATE COUNT		02061F TEMPERATURE			
D	M	Y	H	M	THRESHOLD T.O.U.N	MG/L	O & G	MG/L	MPN	NO/100ML	MPN	NO/100ML	NO/ML	DEG.C.					
2	11	71	13	00	4	0.000	0.6	246.0	4			0		77000		0			
14	12	71	13	30	1	0.001	0.6	298.0	14			9		400		0			
11	1	72	11	00	2	0.004	0.6	440.0	350			26		20		0			
1	2	72	10	45	2	0.000	2.8	324.0	70			21		50		0			
29	2	72	12	00	1	0.001		395.0	49			17		120		0			
SAMPLE DATE		TIME		48004L CADMIUM TOTAL		10605L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L COBALT TOTAL		29008L COPPER TOTAL					
D	M	Y	H	M	CD	CAC03	MG/L	CF	MG/L	F	MG/L	CO	MG/L	CU	MG/L				
2	11	71	13	00		195.0		0.002				0.003		0.005					
14	12	71	13	30	0.003	260.0													
11	1	72	11	00		180.0		0.005				0.006		0.325					
1	2	72	10	45	0.001	205.0		0.002		0.10		0.004		0.011					
29	2	72	12	00	L.001														
SAMPLE DATE		TIME		82005L LEAD TOTAL		25006L MANGANESE TOTAL		28004L NICKEL TOTAL		34003L SELENIUM TOTAL		30006L ZINC TOTAL		80002L MERCURY TOTAL					
D	M	Y	H	M	PB	PN	MG/L	NI	MG/L	SE	MG/L	ZN	MG/L	HG	MG/L				
14	12	71	13	30	0.02	0.05		0.006		L.01		0.014							
1	2	72	10	45	0.02	0.03		0.009		0.01		0.020		.0008					
29	2	72	12	00	0.01	0.01		0.004		0.02		0.077		L.0005					

WATER QUALITY DATA

STATION 00AT05DF207C LATITUDE 53D 22M 20S LONGITUDE 113D 44M 50S

NORTH SASKATCHEWAN RIVER
AT DEVON BRIDGE

SAMPLE DATE TIME				02041L SPECIFIC CONDUCTANCE				10101L ALKALINITY PHENOL				16302L SULPHATE DISSOLVED				11101L SODIUM DISSOLVED				20101L CALCIUM DISSOLVED				09101L OXYGEN DISSOLVED				08202L OXYGEN BIOCHEMICAL DEMAND								
MST				D M Y H M				CACO3 MG/L				CACO3 MG/L				SO4 MG/L				NA MG/L				CA MG/L				O2 MG/L				O2 MG/L				
				2	11	71	15	30									55.				12.				13.7				13.7							
				14	12	71	16	00									65.0				4.				40.0				13.2							
				11	1	72	09	15	175								60.				5.0				48.				12.3							
				1	2	72	09	15	160								65.				4.				30.				10.3							
				29	2	72	09	45																	11.4				0.9							
																																0.5				
SAMPLE DATE TIME				02073L TURBIDITY TOTAL				10301L PH				17201L CHLORIDE DISSOLVED				26103L IRON DISSOLVED				07106L NITROGEN DISSOLVED				07551L NITROGEN DISSOLVED				15406L PHOSPHOROUS TOTAL				19101L POTASSIUM DISSOLVED				
MST				D M Y H M				PH UNITS				CL MG/L				FE+2 + FE+3 MG/L				N MG/L				N MG/L				P MG/L				K MG/L				
				2	11	71	15	30	8.2												0.0				0.1				0.1				1.0			
				14	12	71	16	00	8.1				2.								0.1				0.2				0.7							
				11	1	72	09	15	8.0				3.0				L.1				0.1				L.1				1.0							
				1	2	72	09	15	7.9				5.				L.1				L.1				0.5				1.0							
				29	2	72	09	45	8.3				0.4				L.1				L.1				0.1				0.2							
SAMPLE DATE TIME				02001L ODOUR				06521L OIL & GREASE				10471L RESIDUE TOTAL				36001L COLIFORM TOTAL				36011L COLIFORM FECAL				36900L STANDARD PLATE COUNT				02061F TEMPERATURE								
MST				D M Y H M				MG/L				O & G MG/L				MG/L				MPN NO/100ML				MPN NO/100ML				DEG.C.								
				2	11	71	15	30	0.001				0.6				260.				0				0				0							
				14	12	71	16	00	0.003				0.8				294.				2				20				0							
				11	1	72	09	15	L.001				0.7				310.0				140				26				0							
				1	2	72	09	15	0.003				0.1				318.				240				17				0							
				29	2	72	09	45	0.015								300.				240				22				0							
SAMPLE DATE TIME				48C04L CADMIUM TOTAL				1C605L HARDNESS TOTAL				24004L CHROMIUM TOTAL				09105L FLUORIDE DISSOLVED				27004L COBALT TOTAL				29008L COPPER TOTAL												
MST				D M Y H M				CD MG/L				CACO3 MG/L				F MG/L				CU MG/L																
				2	11	71	15	30	150.												0.003				0.009											
				14	12	71	16	00	230.				0.002								0.003				0.010											
				11	1	72	09	15	205.				0.005				0.10				0.003				0.007											
				29	2	72	09	45	L.001				0.001								0.003				80002L MERCURY TOTAL											
SAMPLE DATE TIME				82005L LEAD TOTAL				25006L MANGANESE TOTAL				34003L SELENIUM TOTAL				30006L ZINC TOTAL				80002L MERCURY TOTAL																
MST				D M Y H M				PB MG/L				MN MG/L				SE MG/L				ZN MG/L				HG MG/L												
				14	12	71	16	00	0.02				0.04				L.01				0.009				.0009											
				1	2	72	09	15	0.01				0.00				0.01				0.070				L.0005											
				29	2	72	09	45	0.01				0.004				0.02				0.023															

B-3

NORTH SASKATCHEWAN RIVER
AT 105 ST. BRIDGE

LATITUDE 53D 29M 55S ---LONGITUDE---113D 30M 30S

LONGITUDE—113° 30' 30S

SAMPLE		DATE		TIME		02041L SPECIFIC CONDUCTANCE		10101L ALKALINITY TOTAL		10151L ALKALINITY PHENOL		16302L SULPHATE DISSOLVED		11101L SODIUM DISSOLVED		20101L CALCIUM DISSOLVED		08101L OXYGEN DISSOLVED		08202L OXYGEN DEMAND	
				MST				CACO3 MG/L		CACO3 MG/L		SO4 MG/L		NA MG/L		CA MG/L		O2 MG/L		MG/L	
D	M	Y	H	M		UMHO/CM															
3	11	71	16	00				155				55.		6.			13.7		0.8		
15	12	71	14	00				165				60.		5.			12.9		0.7		
12	1	72	13	30		320		155				90.0		4.0			11.9		1.0		
1	2	72	14	00				150						5.			10.7		42.		
1	3	72	14	00		380		100				60.					11.3		0.7		

SAMPLE		DATE		TIME		0203L TURBIDITY TOTAL		1030IL PH		1720IL CHLORIDE DISSOLVED		2610L IRON DISSOLVED FE+2 + FE+3		0710L NITROGEN DISS-NITRATE & NITRITE		0755IL NITROGEN DISSOLVED AMMONIA		1540L PHOSPHOROUS TOTAL PHOSPHATE		1910IL POTASSIUM DISSOLVED	
D	M	Y	H	M		TURBIDITY UNITS		PH UNITS		CL MG/L		MG/L		MG/L		N MG/L		P MG/L		K MG/L	
3	11	71	16	00		8.2								0.1		0.1		0.1		1.	
15	12	71	14	00		4.		8.1						0.1		0.2		0.2		0.8	
12	1	72	13	30		7.0		7.0		5.		L.1		L.1		C.1		0.1		1.0	
1	1	72	14	00		3.0		7.7		3.0		L.1		L.1		C.4		0.0		1.0	
1	1	72	14	00		0.3		8.3		4.5		I.1		0.1		0.1		0.2			

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B-4		SAMPLE		DATE		0200IL ODOUR NUMBER		0653IL PHENOLIC MATERIAL		0652IL DIL & GREASE		1047IL RESIDUE TOTAL		3600IL COLIFORM TOTAL		3601IL COLIFORM FECAL		36900IL STANDARD PLATE COUNT		02061F TEMPERATURE	
		MST		T.O.N		NG/L		MG/L		MG/L		MG/L		MPN		MPN		NO/ML		DEG.C.	
D	M	Y	H	M																	
3	11	71	16	00			0.000	0.2	244.		1800		32	1500							
15	12	71	14	00			0.002	1.0	280.		33		7	20							0
12	1	72	13	30			0.001	0.8	270.0		280		9	1410							0
11	2	72	14	00			0.001	2.0	264.		70		17	70							0
1	3	72	14	00			1.001		234.		220		39	100							0

DATE		SAMPLE TIME		48004L CADMIUM TOTAL		10605L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L COBALT TOTAL		23008L COPPER TOTAL		97161F FLOW AVERAGE (DAILY)	
				MST		CD MG/L	CAC03 MG/L		CR MG/L	F MG/L	CO MG/L	CU MG/L	PROVISIONAL CU.FI/SEC				
D	M	Y	H	M													
3	11	71	16	00			200.			0.20					2460		
15	12	71	14	00		0.001	200.	0.002	0.002	0.10	0.004	C.017			1310		
12	1	72	13	30			170.0			0.09					2920		
1	2	72	14	00		0.001	200.	0.005	0.005	0.12	0.006	C.010			2500		
1	3	72	14	00		L.001	210.	0.002	0.002		0.005	0.003			2340		

SAMPLE		DATE		TIME		MST		25006L		28004L		34003L		30006L		80002L	
								MANGANESE		NICKEL		SELENIUM		ZINC		MERCURY	
								TOTAL		TOTAL		TOTAL		TOTAL		TOTAL	
								MG/L		MG/L		MG/L		MG/L		MG/L	
								PB		NI		SE		ZN		HG	
								MG/L		MG/L		MG/L		MG/L		MG/L	
		D	M	Y	H	M											
15	12	71	14	00				0.01	0.006	0.01	0.01	0.01	0.014				
1	3	72	14	00				0.01	0.009	0.02	0.043						
1	3	72	14	00				0.02	0.003	0.01	0.005	0.01	0.098				

WATER QUALITY DATA

STATION 00AT05EA2150

LATITUDE 53D 42M 28S LONGITUDE 113D 14M 3S

NORTH SASKATCHEWAN RIVER
AT FORT SASKATCHEWAN BRIDGE

SAMPLE DATE				02041L SPECIFIC CONDUCTANCE		10101L ALKALINITY TOTAL		10151L ALKALINITY PHENOL		16302L SULPHATE DISSOLVED		20101L CALCIUM DISSOLVED		08101L OXYGEN DISSOLVED		08202L OXYGEN BIOCHEMICAL DEMAND	
D	M	Y	H M	UMHO/CM		CACO3 MG/L		CACO3 MG/L		SO4 MG/L		CA MG/L		O2 MG/L		O2 MG/L	
3	11	71	14 00							65.		10.		13.6		3.2	
15	12	71	12 30									9.		11.2		2.2	
12	1	72	09 30	365		165				60.0		56.0		12.9		2.4	
2	2	72	09 35	350		160				60.		51.		10.2		2.1	
1	3	72	09 00	380		165				60.		54.		12.0		1.2	

SAMPLE DATE				02073L TURBIDITY TOTAL		10301L PH		17201L CHLORIDE DISSOLVED		26103L IRON DISSOLVED FE+2 + FE+3		07106L NITROGEN DISSOLVED NITRATE & NITRITE		15406L PHOSPHOROUS TOTAL PHOSPHATE P		19101L POTASSIUM DISSOLVED	
D	M	Y	H M	TURBIDITY UNITS		PH UNITS		CL MG/L		MG/L		MG/L		MG/L		K MG/L	
3	11	71	14 00	2.		7.7						0.1		0.7		2.	
15	12	71	12 30	3.		8.2		5.				0.2		1.1		1.3	
12	1	72	09 30	5.0		8.1		4.0		L.1		L.1		0.8		1.1	
2	2	72	09 35	2.		7.8		6.		L.1		0.4		0.3		1.1	
1	3	72	09 00	0.2		8.1		0.9		L.1		0.1		0.20		1.6	

SAMPLE DATE				02001L ODOUR THRESHOLD T.O.N		06521L PHENOLIC OIL & GREASE		10471L RESIDUE TOTAL		36001L COLIFORM TOTAL		36001L COLIFORM FECAL		36900L STANDARD PLATE COUNT		02061F TEMPERATURE	
D	M	Y	H M	ODOUR NUMBER		MG/L		MG/L		MPN NO/100ML		MPN NO/100ML		NO/ML		DEG.C.	
3	11	71	14 00	4		0.002		0.1		252.		64		25300		0	
15	12	71	12 30	2		0.006		1.8		1800		4		75000		0	
12	1	72	09 30	2		0.007		1.5		36		0		81000		0	
2	2	72	09 35	2		0.000		1.6		31		7.3		7500		0	
1	3	72	09 00	2		L.001		222.		7800							

SAMPLE DATE				48C04L CADMIUM TOTAL		1C605L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L COBALT TOTAL		29006L COPPER TOTAL		19701L SURFACTANTS ALKYL ARYL SULPHONATE MBAS	
D	M	Y	H M	CD MG/L		CACO3 MG/L		CR MG/L		F MG/L		CO MG/L		CU MG/L		MG/L	
15	12	71	12 30	L.001		90.0		0.005		0.15		0.004		C.007		0.2	
12	1	72	09 30	C.001		210.		0.010		0.005		0.005		C.005		0.25	
1	3	72	09 00	L.001		210.		0.006		0.004		0.004		C.001		0.1	

SAMPLE DATE				82005L LEAD TOTAL		25006L MANGANESE TOTAL		28004L NICKEL TOTAL		34003L SELENIUM TOTAL		30006L ZINC TOTAL		80002L MERCURY TOTAL			
D	M	Y	H M	PB MG/L		MN MG/L		NI MG/L		SE MG/L		ZN MG/L		HG MG/L			
15	12	71	12 30	0.01		0.02		0.006		L.01		0.014					
2	2	72	09 35	0.01		0.01		0.010		0.01		0.040		.0029			
1	3	72	09 00	0.01		0.02		0.009		L.01		0.018		L.0005			

WATER QUALITY DATA

STATION 00AT05EB2170 LATITUDE 53D 52M 45S LONGITUDE 113D 0M 50S

NORTH SASKATCHEWAN RIVER
AT VINCA TRAILER SITE

AT VINCA TRAILER SITE											
SAMPLE TIME				02041L SPECIFIC CONDUCTANCE	10101L ALKALINITY TOTAL	10151L ALKALINITY PHENOL	16302L SULPHATE DISSOLVED	11101L SODIUM DISSOLVED	20101L CALCIUM DISSOLVED	08101L OXYGEN DISSOLVED	08202L OXYGEN BIOCHEMICAL DEMAND
DATE	TIME	MST	D M Y H M	UMHO/CM	CACO3 MG/L	CACO3 MG/L	SO4 MG/L	NA MG/L	CA MG/L	O2 MG/L	02 MG/L
3 11	71 11 30						80.	19.		13.5	3.5
15 12	71 11 00							12.		9.5	1.9
12 1	72 12 00				165		60.0	17.0	60.0	11.0	3.0
2 2	72 12 35			345	155		60.	10.	67.	9.7	1.0
1 3	72 11 50			400	160				55.	10.4	1.9
SAMPLE TIME				02073L TURBIDITY TOTAL	17201L CHLORIDE DISSOLVED	26103L IRON DISSOLVED	07106L NITROGEN DISS. NITRATE	07551L NITROGEN DISSOLVED	15406L PHOSPHOROUS TOTAL	19101L POTASSIUM DISSOLVED	
DATE	TIME	MST	D M Y H M	UNITS	CL MG/L	FE MG/L	FE+2 + FE+3 MG/L	N MG/L	P MG/L	K MG/L	
3 11	71 11 30			3.0				1.7	1.0	3.	
15 12	71 11 00			2.	6.			0.8	0.8	1.8	
12 1	72 12 00					L.1		0.1	0.6	1.5	
2 2	72 12 35			4.	4.	L.1		1.6	1.5	1.7	
1 3	72 11 50			0.3	1.4	L.1		1.3	0.9		
SAMPLE TIME				02001L ODOUR THRESHOLD NUMBER	06521L OIL & GREASE	10471L RESIDUE TOTAL	36001L COLIFORM TOTAL	36011L COLIFORM FECAL	36900L STANDARD PLATE COUNT	02061F TEMPERATURE	
DATE	TIME	MST	D M Y H M	T.O.N	O & G MG/L	MG/L	MPN NO/100ML	MPN NO/100ML	NO/ML	DEG.C.	
3 11	71 11 30			8	0.2	298.	430	54	52000	0	
15 12	71 11 00			4	1.6	290.	1800	22	1600	0	
12 1	72 12 00			2		270.	72	7	64000	0	
2 2	72 12 35			2		316.	62	19	42000	0	
1 3	72 11 50			1		248.	1800		10100	0	
SAMPLE TIME				48004L CADMIUM TOTAL	24004L CHROMIUM TOTAL	09105L FLUORIDE DISSOLVED	27004L COBALT TOTAL	25008L COPPER TOTAL			
DATE	TIME	MST	D M Y H M	MG/L	CR MG/L	F MG/L	CO MG/L	CU MG/L			
3 11	71 11 30				0.013	0.24	0.004	0.007			
15 12	71 11 00			200.0							
12 1	72 12 00			210.	0.015		0.004	0.005			
2 2	72 12 35			220.	0.009	0.15	0.005	0.007			
1 3	72 11 50										
SAMPLE TIME				82005L LEAD TOTAL	25006L MANGANESE TOTAL	34003L SELENIUM TOTAL	30006L ZINC TOTAL	80002L MERCURY TOTAL			
DATE	TIME	MST	D M Y H M	MG/L	NI MG/L	SE MG/L	ZN MG/L	HG MG/L			
3 11	71 11 30										
15 12	71 11 00			0.01	0.008	L.01	0.013	.0008			
2 2	72 12 35			0.01	0.018	0.01	0.044	L.0005			
1 3	72 11 50			0.02	0.010	0.01	0.033				

NORTH SASKATCHEWAN RIVER
AT WASKATENAU BRIDGE

[illegible]

DATE		SAMPLE TIME			02C73L TURBIDITY TOTAL		10301L PH	17201L CHLORIDE DISSOLVED		26103L IRON DISSOLVED FE+2 + FE+3		07106L NITROGEN DISS-NITRATE & NITRITE		07561L NITROGEN DISSOLVED AMMONIA		15406L PHOSPHOROUS TOTAL PHOSPHATE		19101L POTASSIUM DISSOLVED	
D	M	Y	H	M	MST	TURBIDITY UNITS	PH	CL MG/L	FE MG/L	N MG/L	N MG/L	P MG/L	K MG/L						
3	11	71	10	00		2.	8.2			0.4	1.6	0.9	2.						
13	12	71	09	30		3.0	8.2	9.		0.5	0.9	0.9	1.8						
12	2	72	11	15		2.	8.1	8.0	1.1	0.2	0.8	0.5	1.6						
12	2	72	11	05		0.2	7.9	5.	1.1	0.2	1.2	0.7	1.2						
1	1	72	10	30		0.2	8.	1.3	1.1	1.1	0.7								

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[illegible]

DATE		SAMPLE TIME			48004L CADIUM TOTAL		16005L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L COBALT TOTAL		29008L COPPER TOTAL	
D	M	Y	H	M	CD MG/L	CACC3 MG/L		CR MG/L	F MG/L	CO MG/L	CU MG/L					
MST																
15	12	71	09	30	L.001			0.009		0.004	C.007					
12	1	72	11	15		240.		0.005		0.004	C.011					
12	1	72	11	05	C.001	205.		0.006		0.005	C.003					
1	3	72	10	30	L.001	210.			0.15							

DATE	SAMPLE TIME	8200CL LEAD		25006L MANGANESE		28004L NICKEL		34003L SELENIUM		30006L ZINC		80002L MERCURY	
		D	M	Y	H	M	MG/L	NI MG/L	SE MG/L	ZN MG/L	HG MG/L	TOTAL	TOTAL
15	12	71	09	30	0.02	0.12	0.012	0.012	0.012	0.012	0.0005		
2	12	72	11	05	0.01	0.04	0.004	0.01	0.039	0.058			
2	12	73	10	30	0.00	0.00	0.003	0.01	0.005	1.0005			

STATION 00AT05ED2210 - LATITUDE ---53D 47M-20S--- LONGITUDE---111D 41M 30S---

NORTH SASKATCHEWAN RIVER
AT DUVERNEY

NORTH SASKATCHEWAN RIVER
AT DUVERNEY

AT DUVERNEY																	
SAMPLE		SPECIFIC		10101L		10151L		16302L		11101L		20101L		09101L		08202L	
DATE		TIME		CONDUCTANCE		ALKALINITY		SULPHATE		SODIUM		CALCIUM		OXYGEN		BIOCHEMICAL	
MST						PHENOL		DISSOLVED		DISSOLVED		DISSOLVED		DEMAND			
D	M	Y	H	M	UMHO/CM	CACO3	CACO3	SO4	NA	CA	O2	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
3	11	71	10	30				70.	23.	14.3					1.8		
15	12	71	08	00					14.	7.8					0.8		
12	1	72	09	40	415	110		70.0	13.0	56.0				9.2	2.2		
12	2	72	10	00		165		60.	18.	60.				7.7			
1	3	72	09	30	400	150		60.		58.				8.4	2.1		
19101L																	
SAMPLE		TIME		TURBIDITY		CHLORIDE		DISSOLVED		NITROGEN		PHOSPHOROUS		POTASSIUM		DISSOLVED	
DATE				UNITS		MG/L		FE+2 + FE+3		AMMONIA		TOTAL		TEMPERATURE			
MST																	
D	M	Y	H	M	PH	CL	MG/L	FE	N	N	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
3	11	71	10	30	8.4				0.4	1.3		0.7		2.			
15	12	71	08	00	8.0	6.			0.4	0.9		1.0		1.7			
12	1	72	09	40	8.2	9.0		L.1	0.3	1.2		0.8		1.6			
12	2	72	10	00	7.8	8.		L.1	0.3	1.2		0.1					
1	3	72	09	30	8.1	1.5		L.1	0.5	1.1		0.7					
36900L																	
SAMPLE		TIME		ODOUR		OIL & GREASE		RESIDUE		COLIFORM		STANDARD PLATE		TEMPERATURE			
DATE				THRESHOLD		MG/L		MG/L		NO/100ML		COUNT		DEG.C.			
MST				I.O.N													
D	M	Y	H	M	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
3	11	71	10	30	0.005	0.4		302.	11	0		30000					
15	12	71	08	00	4	0.8		338.	170	11		1800					
12	1	72	09	40	2	0.4		290.0	22	11		5100					
12	2	72	10	00	2	1.5		315.	35	0		105000					
1	3	72	09	30	1	0.007		264.		0		31500					
29008L																	
SAMPLE		TIME		CADMIUM		CHROMIUM		FLUORIDE		COBALT		COPPER		ZINC		MERCURY	
DATE				TOTAL		TOTAL		DISSOLVED		TOTAL		TOTAL		TOTAL		TOTAL	
MST																	
D	M	Y	H	M	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
3	11	71	10	30	0.001	0.007		0.00	.0.004	0.006							
15	12	71	08	00	200.	0.007			0.005	0.017							
12	1	72	09	40	235.	0.001		0.20	0.005	0.003							
1	3	72	09	30	210.												
80002L																	
SAMPLE		TIME		LEAD		MANGANESE		SELENIUM		ZINC		MERCURY		HG			
DATE				TOTAL		TOTAL		TOTAL		TOTAL		TOTAL		TOTAL			
MST																	
D	M	Y	H	M	PB	MN	NI	SE	ZN	HG	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
3	11	71	10	30	0.01	0.02	0.016	L.01	0.012	.0023							
15	12	71	08	00	0.01	0.01	0.020	L.01	0.062	L.0005							
12	1	72	09	40	0.01	0.01	0.012	L.01	0.076								
1	3	72	09	30	0.01	0.01	0.012	L.01	0.076								

WATER QUALITY DATA

STATION 00AT05ED2220 LATITUDE 53D 51M 30S LONGITUDE 110D 36M 05

NORTH SASKATCHEWAN RIVER
AT LINDBERGH

SAMPLE TIME			02041L SPECIFIC CONDUCTANCE		10101L ALKALINITY TOTAL		10151L ALKALINITY PHENOL		16302L SULPHATE DISSOLVED		11101L SODIUM DISSOLVED		20101L CALCIUM DISSOLVED		08101L OXYGEN DISSOLVED		08202L OXYGEN BIOCHEMICAL DEMAND	
DATE	D	M	Y	H	M	UMHO/CM	CACO3 MG/L	CACO3 MG/L	CACO3 MG/L	SO4 MG/L	NA MG/L	CA MG/L	O2 MG/L	O2 MG/L	O2 MG/L	O2 MG/L	O2 MG/L	
	3	11	71	12	00					60.	19.		14.4	14.4	1.0	1.0	1.0	
	15	12	71	11	30						15.		7.9	7.9	0.5	0.5	0.5	
	12	1	72	11	15	420	175			70.0	11.0	56.0	10.8	10.8	1.0	1.0	1.0	
	2	2	72	12	00					55.	11.	56.	7.1	7.1	2.0	2.0	2.0	
	1	3	72	11	30	405	155			65.			6.9	6.9	1.6	1.6	1.6	

SAMPLE TIME			02073L TURBIDITY TOTAL		10301L PH		17201L CHLORIDE DISSOLVED		26103L IRON DISSOLVED		07106L NITROGEN DISS. NITRATE & NITRITE		07551L NITROGEN DISSOLVED AMMONIA		15406L PHOSPHOROUS TOTAL PHOSPHATE		19101L POTASSIUM DISSOLVED	
DATE	D	M	Y	H	M	TURBIDITY UNITS	PH UNITS	CL MG/L	FE MG/L	FE MG/L	N MG/L	N MG/L	N MG/L	N MG/L	P MG/L	P MG/L	K MG/L	
	3	11	71	12	00		7.9	10.			0.6	0.4	0.4	0.4	0.3	0.3	1.7	
	15	12	71	11	30	1.0	8.0	10.0	L.1		0.4	1.2	1.2	0.9	0.9	1.6	1.6	
	12	1	72	11	15	1.0	7.8	10.0	L.1		0.4	1.6	1.6	0.2	0.2	1.5	1.5	
	2	2	72	12	00	0.2		1.9	L.1		0.6	1.0	1.0	0.5	0.5			
	1	3	72	11	30													

SAMPLE TIME			02001L ODOUR		06531L PHENOLIC MATERIAL		06521L OIL & GREASE		10471L RESIDUE TOTAL		36001L COLIFORM TOTAL		36011L FECAL		36900L STANDARD PLATE COUNT		02061F TEMPERATURE	
DATE	D	M	Y	H	M	ODOUR THRESHOLD T.O.N	MG/L	O & G MG/L	MG/L	MPN NO/100ML	MPN NO/100ML	MPN NO/100ML	MPN NO/100ML	NO/ML	NO/ML	DEG.C.	DEG.C.	
	3	11	71	12	00	4	0.000	0.1	280.	0	33	0	11	35000	35000	0	0	
	15	12	71	11	30	4	0.009	2.5	326.	33	350	27	27	500	500	0	0	
	12	1	72	11	15	2	0.005	0.8	410.0					20900	20900	0	0	
	2	2	72	12	00	2	0.001	1.6	374.	1600		10	10	5000	5000	0	0	
	1	3	72	11	30	2	0.003		314.									

SAMPLE TIME			48004L CADMIUM TOTAL		10605L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L COBALT TOTAL		29008L COPPER TOTAL					
DATE	D	M	Y	H	M	CD MG/L	CACO3 MG/L	CR MG/L	F MG/L	CO MG/L	CU MG/L	CU MG/L	CU MG/L	CU MG/L				
	15	12	71	11	30	0.002	200.0	0.005		0.004	0.067	0.067	0.067	0.067				
	12	1	72	11	15	0.001	210.	0.007	0.15	0.002	0.032	0.032	0.032	0.032				
	1	3	72	11	30	0.003	200.	0.003		0.006	0.006	0.006	0.006	0.006				

SAMPLE TIME			82005L LEAD TOTAL		25006L MANGANESE TOTAL		28004L NICKEL TOTAL		34003L SELENIUM TOTAL		30006L ZINC TOTAL		80002L MERCURY TOTAL					
DATE	D	M	Y	H	M	PB MG/L	MN MG/L	NI MG/L	SE MG/L	ZN MG/L	ZN MG/L	HG MG/L	HG MG/L	HG MG/L				
	15	12	71	11	30	0.02	0.01	0.014	L.01	0.017	0.017	.0005	.0005	.0005				
	12	1	72	12	00	0.02	0.01	0.018	0.01	0.062	0.062	L.0005	L.0005	L.0005				
	1	3	72	11	30	0.01	0.01	0.004	0.01	0.009	0.009							

WATER QUALITY DATA

STATION 004705EE2240
LATITUDE 53D 35M 50S LONGITUDE 109D 39M 23S

NORTH SASKATCHEWAN FERRY
AT LLOYDMINSTER FERRY

AT LLOYDMINSTER FERRY																			
DATE		SAMPLE TIME		02041L SPECIFIC CONDUCTANCE		10101L ALKALINITY TOTAL		10151L ALKALINITY PHENOL		16302L SULPHATE DISSOLVED		11101L SODIUM DISSOLVED		20101L CALCIUM DISSOLVED		08101L OXYGEN DISSOLVED		08202L OXYGEN BIOCHEMICAL DEMAND	
MST		MST		UMHO/CM		CACO3 MG/L		CACO3 MG/L		SD4 MG/L		NA MG/L		CA MG/L		O2 MG/L		O2 MG/L	
D	M	Y	H	M															
3	11	71	16	00		175	25.			65.		28.			14.5		1.1		
15	12	71	13	30		185				70.		20.			9.1		1.2		
12	1	72	13	00		175						16.0		56.0	7.5		1.6		
2	2	72	15	00		170				65.		16.		60.	6.7		2.6		
1	3	72	13	30		165				65.				53.	7.2		1.9		

DATE		SAMPLE TIME		02073L TURBIDITY TOTAL		10301L PH		17201L CHLORIDE DISSOLVED		26103L IRON DISSOLVED		07106L NITROGEN DISSOLVED		07551L NITROGEN DISSOLVED		15406L PHOSPHOROUS TOTAL		19101L PHOSPHOROUS DISSOLVED	
MST		MST		UNITS		PH UNITS		CL MG/L		FE MG/L		N MG/L		N MG/L		P MG/L		K MG/L	
D	M	Y	H	M															
3	11	71	16	00		8.4		20.				0.5		0.4		0.6		0.6	
15	12	71	13	30		8.0		26.0				0.6		1.5		0.9		3.	
12	1	72	13	00		8.0		65.		L.1		L.1		1.1		0.7		2.6	
2	2	72	15	00		7.7				L.1		0.6		1.2		0.1		1.9	
1	3	72	13	30		7.9		4.2		L.1		0.6		0.9		0.8		2.0	

DATE		SAMPLE TIME		02001L ODOUR		06531L PHENOLIC MATERIAL		06521L OIL & GREASE		10471L RESIDUE TOTAL		36001L CULIFORM TOTAL		36011L COLIFORM FECAL		36900L STANDARD PLATE COUNT		02061F TEMPERATURE	
MST		MST		THRESHOLD T.O.N		O & G MG/L		O & G MG/L		MG/L		MPN NO/100ML		MPN NO/100ML		' NO/ML		DEG-C.	
D	M	Y	H	M															
3	11	71	16	00		0.009		0.2		320.		0		0		1800		0	
15	12	71	13	30		0.010		2.5		340.		33		0		290		0	
12	1	72	13	00		0.003		0.2		290.0		23		5		8300		0	
2	2	72	15	00		0.002		1.5										0	
1	3	72	13	30		0.005				332.		1800		5		9200		0	

DATE		SAMPLE TIME		48C04L CADMIUM TOTAL		16C05L HARDNESS TOTAL		24004L CHROMIUM TOTAL		09105L FLUORIDE DISSOLVED		27004L CORALY TOTAL		29008L COPPER TOTAL		10701L SURFACTANTS ALKYL ARL SULPHONATE		02061F TEMPERATURE	
MST		MST		MG/L		CACO3 MG/L		CR MG/L		F MG/L		CO MG/L		CU MG/L		MBAS		DEG-C.	
D	M	Y	H	M															
3	11	71	16	00		260.		0.005		0.17		0.004		0.435		0.1		0	
15	12	71	13	30		200.0				0.12		0.004		0.008		0.15		0	
12	1	72	13	00		215.		0.007		0.12		0.00		0.004		L.1		0	
2	2	72	15	00		225.		0.001		0.15		0.005		0.004				0	
1	3	72	13	30				0.001										0	

DATE		SAMPLE TIME		82006L LEAD TOTAL		25006L MANGANESE TOTAL		28004L NICKEL TOTAL		34003L SELENIUM TOTAL		30006L ZINC TOTAL		80002L MERCURY TOTAL		02061F TEMPERATURE	
MST		MST		MG/L		MG/L		MG/L		MG/L		MG/L		MG/L		DEG-C.	
D	M	Y	H	M													
3	11	71	16	00													
15	12	71	13	30													
12	1	72	13	00													
2	2	72	15	00													
1	3	72	13	30													

DATE		SAMPLE TIME		02001L ODOUR		06531L PHENOLIC MATERIAL		06521L OIL & GREASE		10471L RESIDUE TOTAL		36001L CULIFORM TOTAL		36011L COLIFORM FECAL		36900L STANDARD PLATE COUNT		02061F TEMPERATURE	
MST		MST		THRESHOLD T.O.N		O & G MG/L		O & G MG/L		MG/L		MPN NO/100ML		MPN NO/100ML		' NO/ML		DEG-C.	
D	M	Y	H	M															
3	11	71	16	00		0.009		0.2		320.		0		0		1800		0	
15	12	71	13	30		0.010		2.5		340.		33		0		290		0	
12	1	72	13	00		0.003		0.2		290.0		23		5		8300		0	
2	2	72	15	00		0.002		1.5										0	
1	3	72	13	30		0.005				332.		1800		5		9200		0	

ANALYTICAL RESULTS FOR EDMONTON STORM SEWERS
March 15, 1972

	Quesnell Bridge (south side)	Near Whitemud Creek	Emily Murphy Park	Near Groat Bridge (N.Side)
pH	7.6	7.0	7.1	7.0
Chloride dissolved (mg/l)	L 1	L 1	10	L 1
Iron: Total (mg/l)	0.7	1.0	12.0	0.8
Magnesium: dissolved (mg/l)	13	5	7	8
Nitrogen: nitrate & nitrite (mg/l)	0.8	0.3	0.4	0.2
Potassium: dissolved (mg/l)	40	3.8	5.3	4.0
Specific Conductance (umho/cm)	2590	740	1160	660
Alkalinity: Total (CaCO ₃) (mg/l)	125	100	80	95
Hardness: Total (CaCO ₃) (mg/l)	215	105	85	120
Calcium: dissolved (mg/l)	64	34	23	34
Sulphate: dissolved (mg/l)	50	35	25	25
Sodium: dissolved (mg/l)	400	113	200	63
Odor	20	500	100	500
Oil & Grease (mg/l)	1.3	32.7	12.6	25.2
Phenols (mg/l)	0.018	0.050	0.048	0.020
Cadium: Total (mg/l)	0.005	0.003	0.003	0.003
Chromium: Total (mg/l)	0.019	0.022	0.030	0.040
Cobalt: Total (mg/l)	0.026	0.020	0.027	0.019
Copper: Total (mg/l)	0.020	0.027	0.065	0.147
Lead: Total (mg/l)	0.446	0.949	1.339	0.781
Manganese: Total (mg/l)	0.557	1.076	1.376	0.903
Mercury: Total (mg/l)	L 0.0005	L 0.0005	0.0011	0.0009
Nickel: Total (mg/l)	0.057	0.053	0.067	0.017
Selenium: Total (mg/l)	0.02	0.01	0.01	0.01
Zinc: Total (mg/l)	0.353	0.496	0.642	0.438

ANALYTICAL RESULTS FOR EDMONTON STORM SEWERS
March 20, 1972

	Quesnell Bridge (South side)	Quesnell Bridge (North side)	near Whitemud Creek	Groat Bridge (North side)	Emily Murphy Park
pH	7.7	7.3	7.1	7.0	7.3
Alkalinity (as CaCO_3) (mg/l)	105	60	70	85	45
Threshold Odor	10 E	10 CH	10 CH	100 CH	20 E
Oils & Greases (mg/l)	0.1	4.2	4.3	8.6	0.5
Phenols (ppb)	3	13	2	5	2
Chlorides (mg/l)	28	38	40	42	30
Nitrate nitrogen (mg/l)	0.6	0.7	0.6	0.5	0.4
Sulphates (mg/l)	60	30	35	45	15

ANALYTICAL RESULTS FOR EDMONTON STORM SEWERS
March 23, 1972

	Aspen Drive West	East of Dawson Bridge	Capilano Bridge (South-east)
pH	8.5	7.1	7.1
Alkalinity (as CaCO_3) mg/l	105	195	140
Threshold Odor	2 E	200 CH	100 CH
Oils & Greases mg/l	4.3	15.8	11.7
Phenols ppb	15	1	30
Chlorides mg/l	39	70	56
Nitrate & Nitrogen mg/l	0.8	0.1	0.1
Sulphates mg/l	45	-	-
Cadmium: Total mg/l	0.001	0.003	0.005
Chromium: Total mg/l	0.022	0.176	0.045
Cobalt: Total mg/l	0.010	0.021	0.020
Copper: Total mg/l	0.050	0.119	0.071
Lead: Total mg/l	0.013	1.291	0.958
Manganese: Total mg/l	0.453	1.192	0.999
Mercury: Total mg/l	0.0005	0.0005	0.0005
Nickel: Total mg/l	0.036	0.085	0.090
Selenium: Total mg/l	0.02	0.01	0.01
Zinc: Total mg/l	0.159	0.941	1.011

ANALYTICAL RESULTS FOR EDMONTON SNOW DUMPS
March 15, 1972

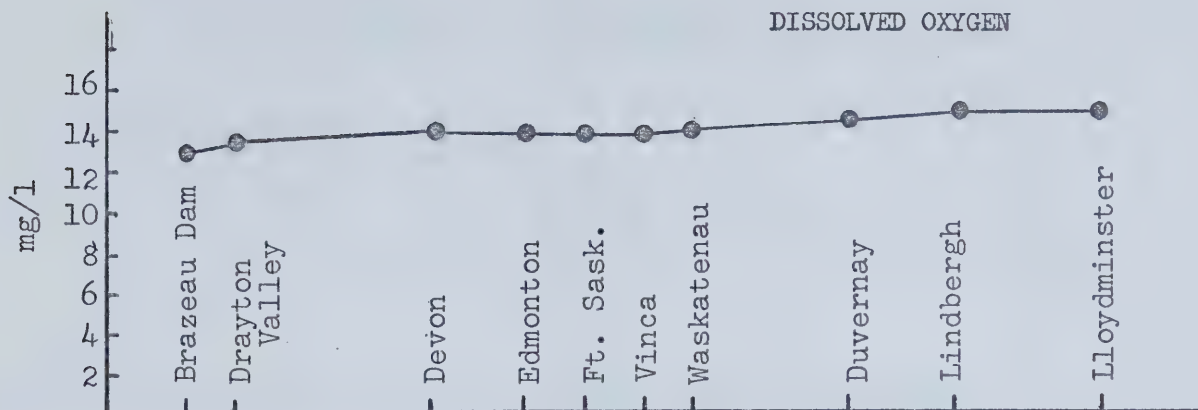
	<u>Whitemud Creek</u>	<u>Laurier Park</u>	<u>Groat Bridge</u>	<u>Grierson Hill</u>	<u>Dawson Bridge</u>	<u>50th Street</u>
pH	8.3	7.3	8.3	8.1	8.0	8.0
Alkalinity (as CaCO ₃) mg/l	80	90	110	95	105	100
Threshold Odor	20 C	100 CH	10 C	10 C	500 CH	10 C
Oils and Greases mg/l	49.3	73.0	-	201.9	135.1	65.4
Phenols ppb	0	0	0	20	8	9
Chlorides mg/l	36	170	530	270	210	500
Nitrate Nitrogen mg/l	0.3	0.3	0.5	0.3	0.2	0.2
Sulphates	20	10	15	-	20	75
Sodium mg/l	138	43	225	125	350	550
Potassium mg/l	3.1	4	3.2	6.0	4.0	36
Cadmium: Total mg/l	0.003	0.006	0.007	0.010	0.007	0.004
Chromium: Total mg/l	0.030	0.037	0.060	0.072	0.038	0.048
Cobalt: Total mg/l	0.038	0.065	0.083	0.111	0.062	0.057
Copper: Total mg/l	0.095	0.005	0.236	0.400	0.172	0.123
Lead: Total mg/l	1.898	2.958	4.187	6.141	3.573	1.926
Manganese: Total mg/l	2.092	3.230	3.461	5.153	2.846	2.634
Mercury: Total mg/l	0.0007	0.0007	0.0007	0.0008	0.0005	0.0010
Nickel: Total mg/l	0.094	0.137	0.187	1.125	0.137	0.127
Selenium: Total mg/l	0.01	0.03	0.01	0.01	0.02	0.02
Zinc: Total mg/l	0.699	0.954	1.361	2.483	1.052	0.718
Benzo-a-Pyrene mg/l	0.001	0.001	0.001	0.001	0.001	0.001

NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

NOVEMBER 2 - 3, 1971

River Discharge 2460 c.f.s. at Edmonton

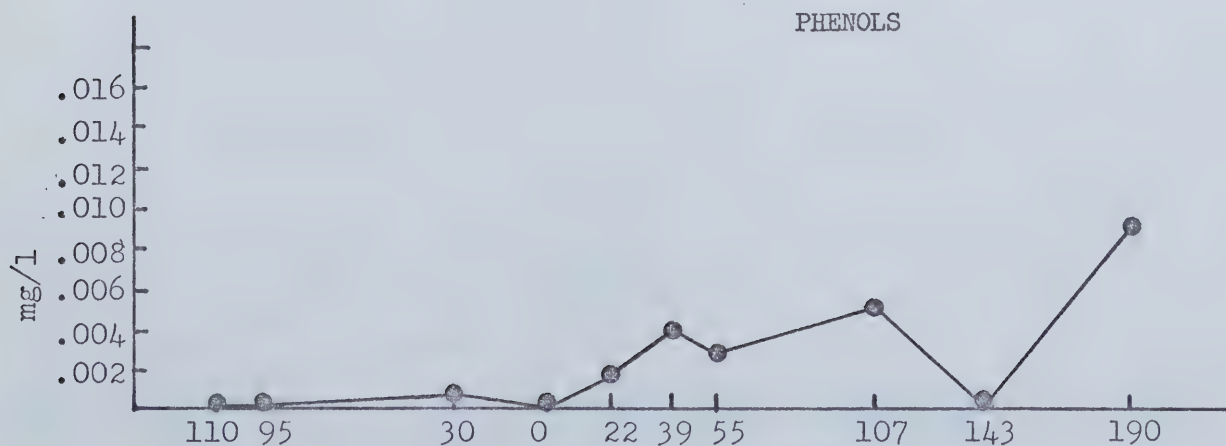
DISSOLVED OXYGEN



BIOCHEMICAL OXYGEN DEMAND



PHENOLS

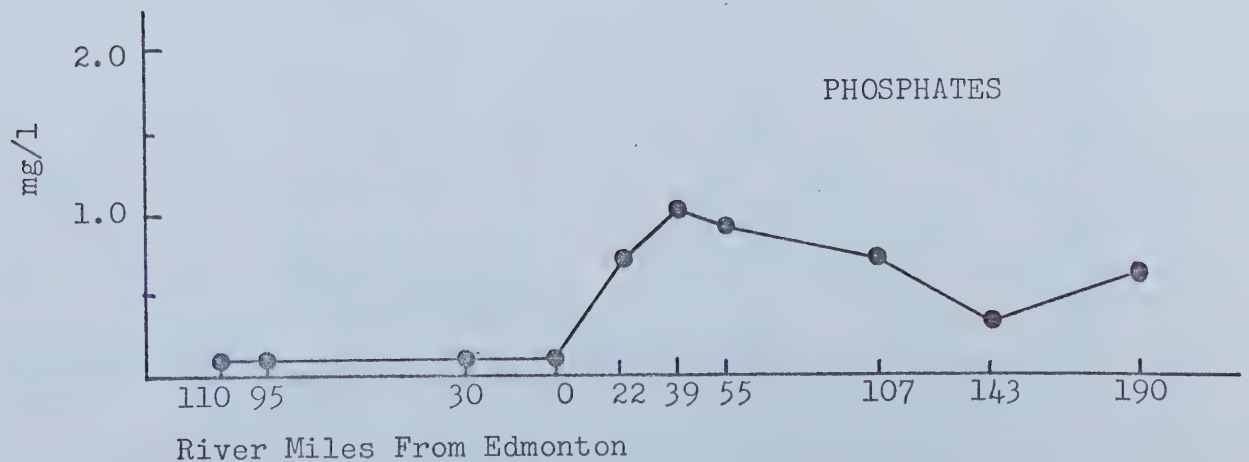
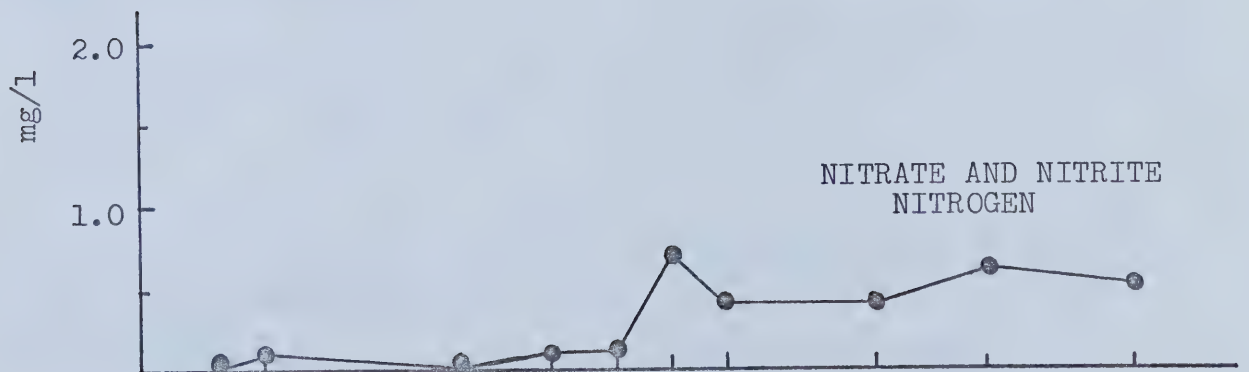
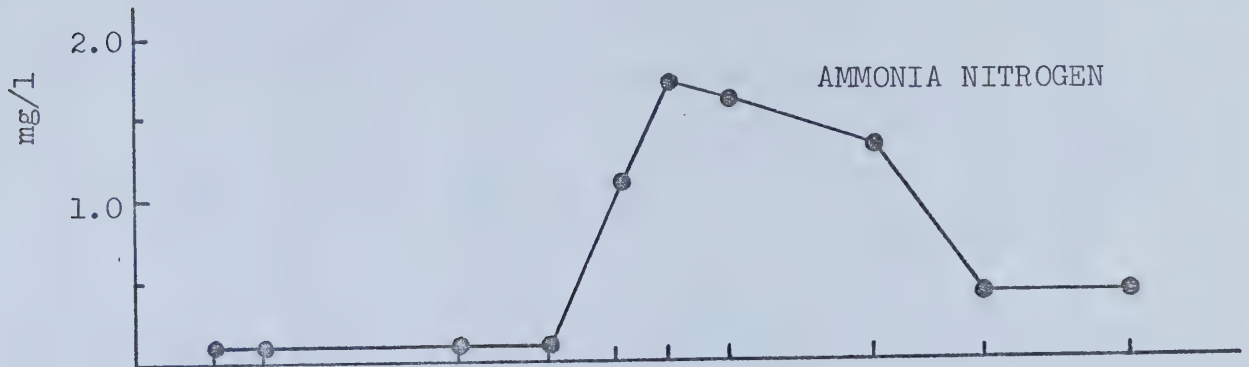


River Miles From Edmonton

NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

November 2 - 3, 1971

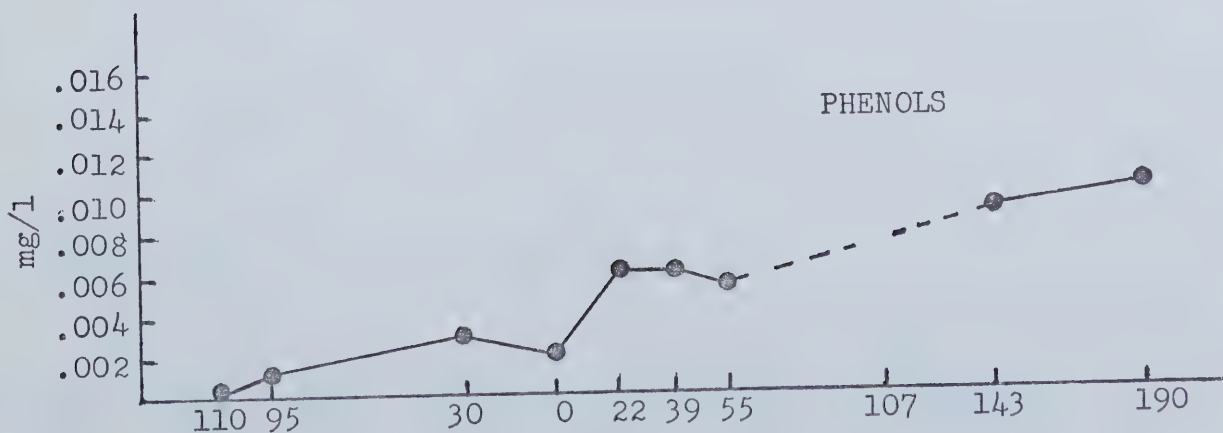
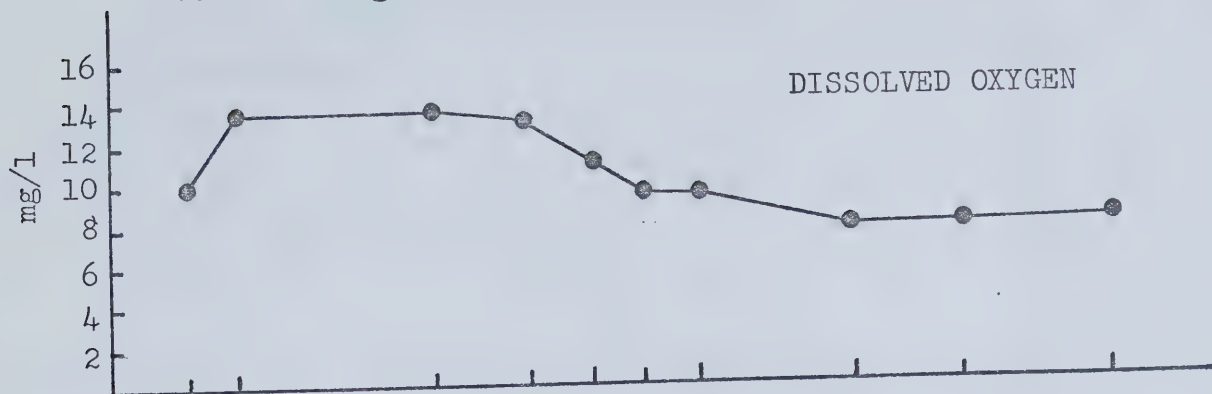
River Discharge 2460 c.f.s. at Edmonton



NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

December 14 - 15, 1971

River discharge 1370 c.f.s. at Edmonton

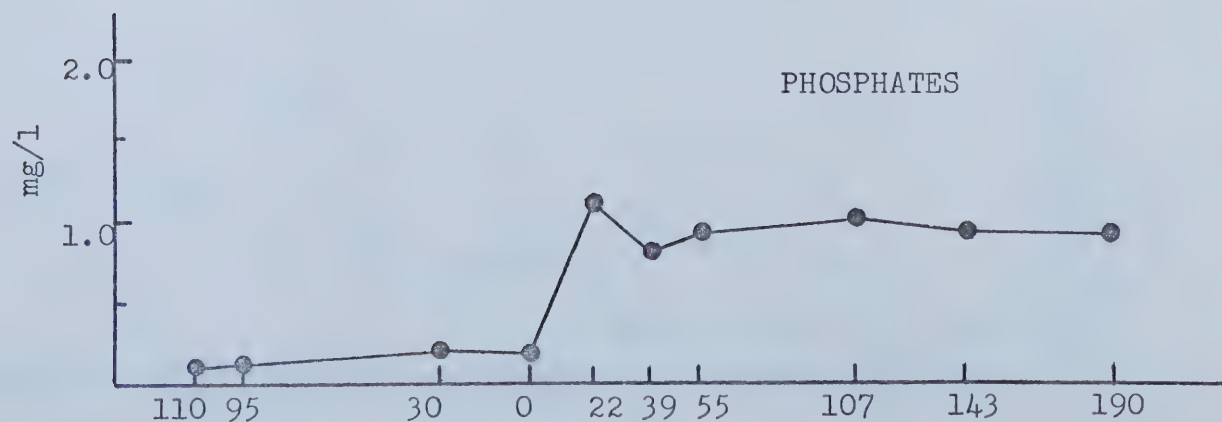
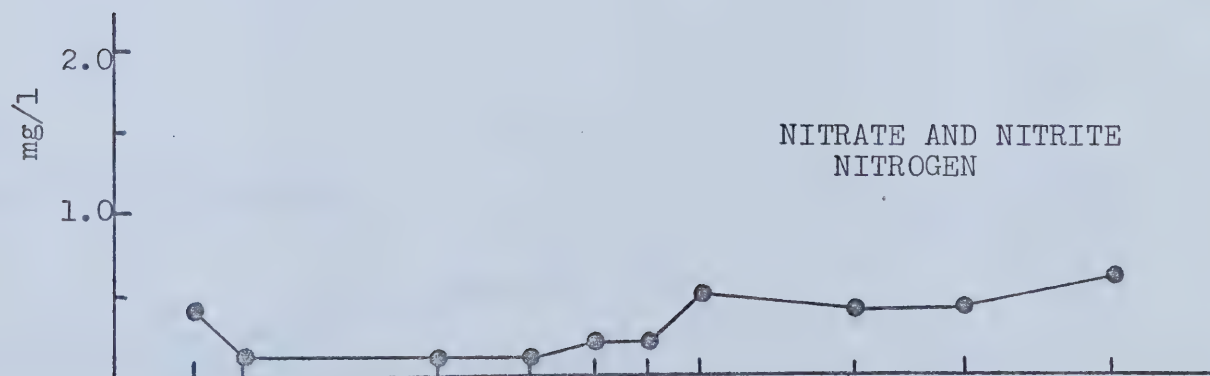
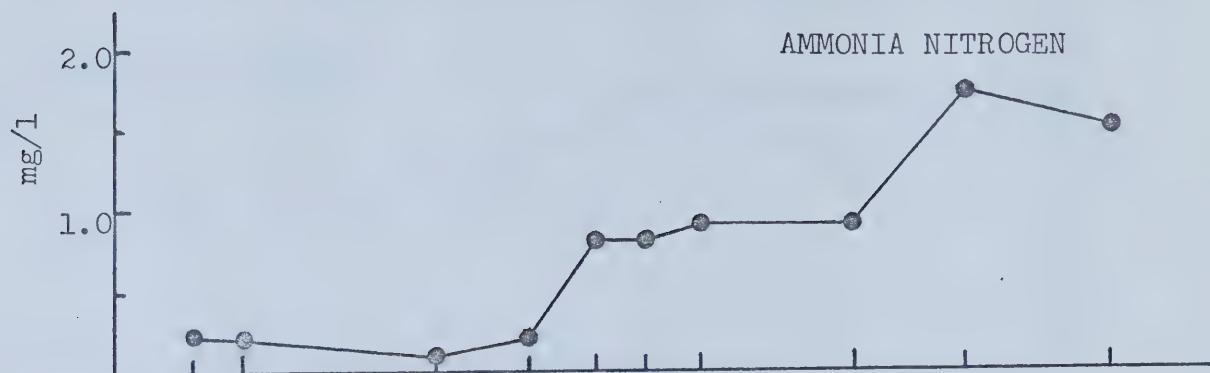


River Miles From Edmonton

NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

December 14 - 15, 1971

River discharge 1370 c.f.s. at Edmonton

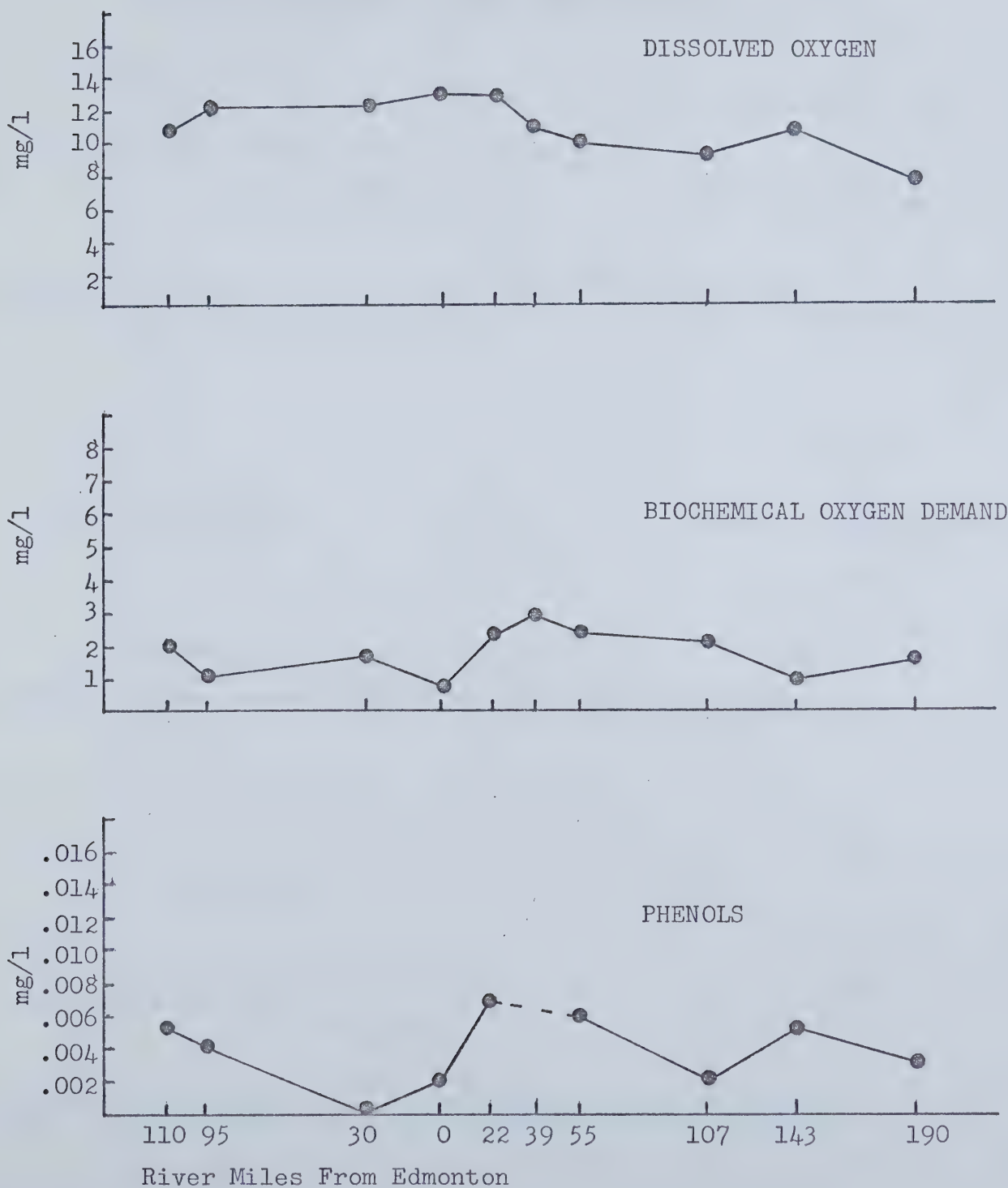


River Miles From Edmonton

NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

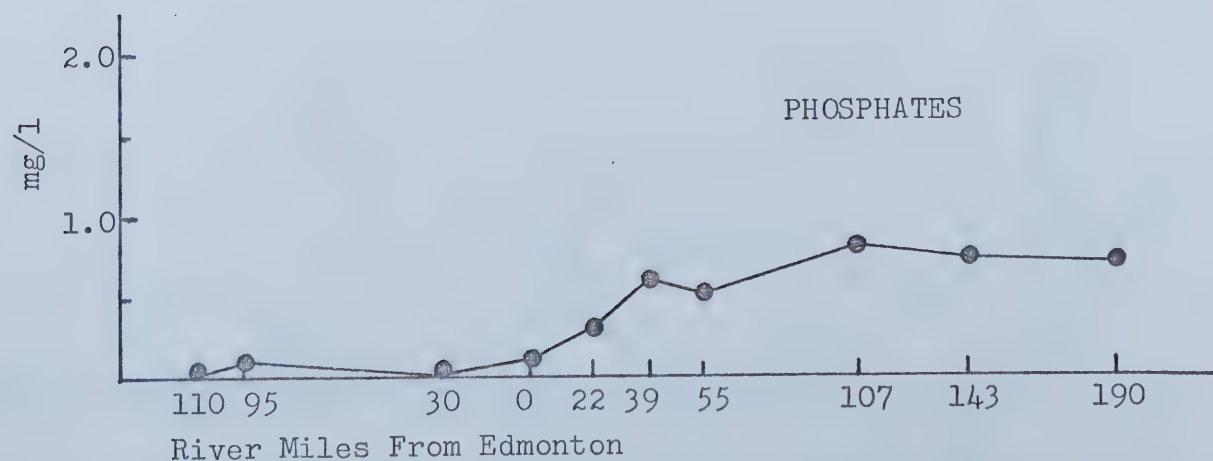
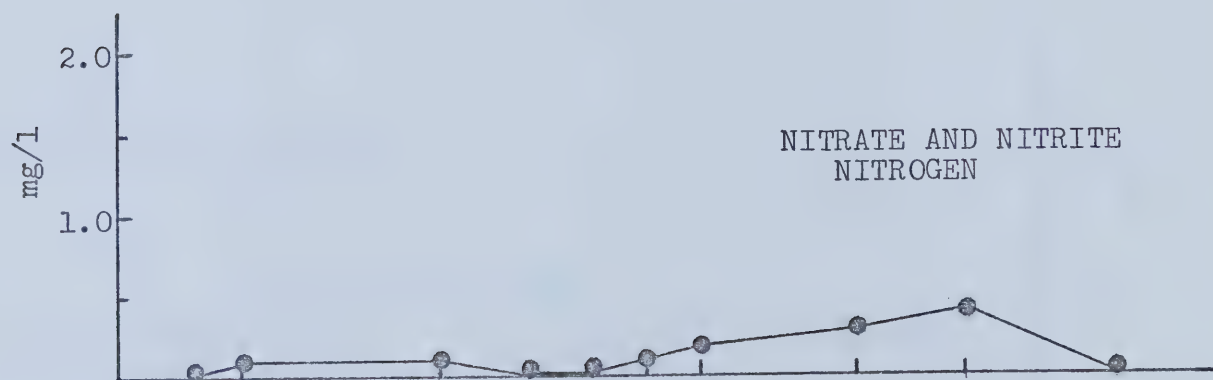
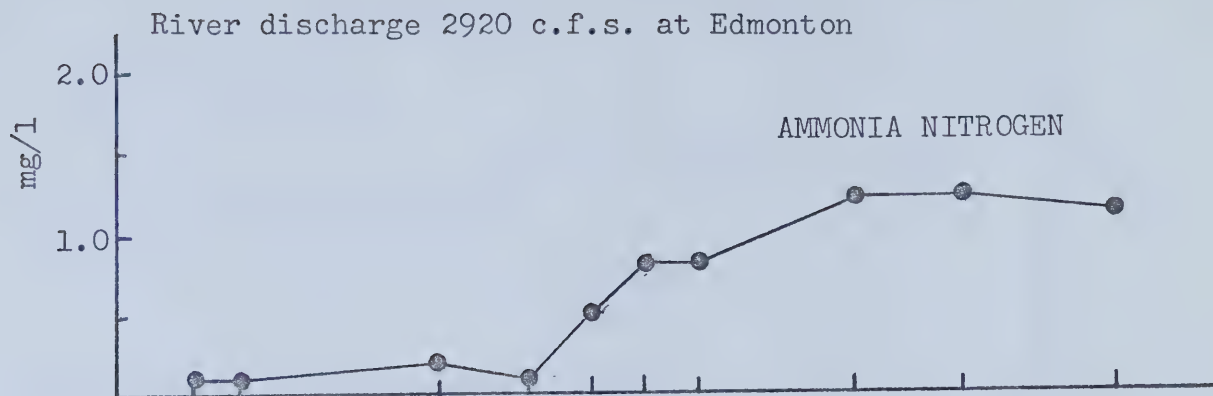
January 11 - 12, 1972

River discharge 2920 c.f.s. at Edmonton



NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

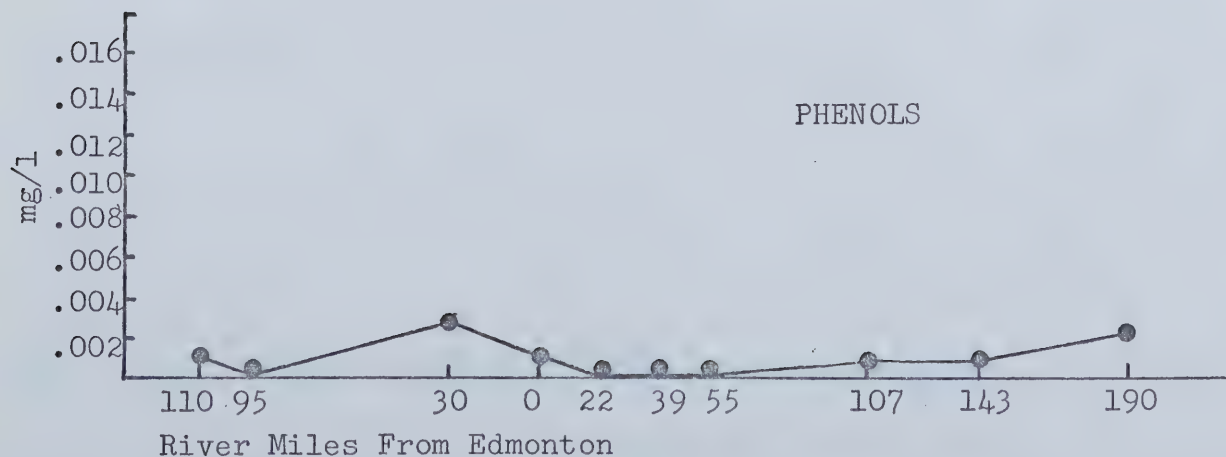
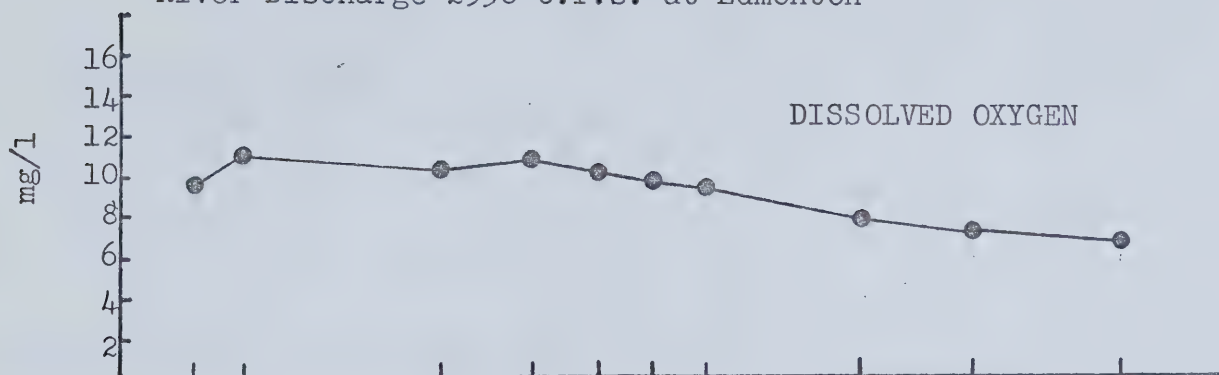
January 11 - 12, 1972



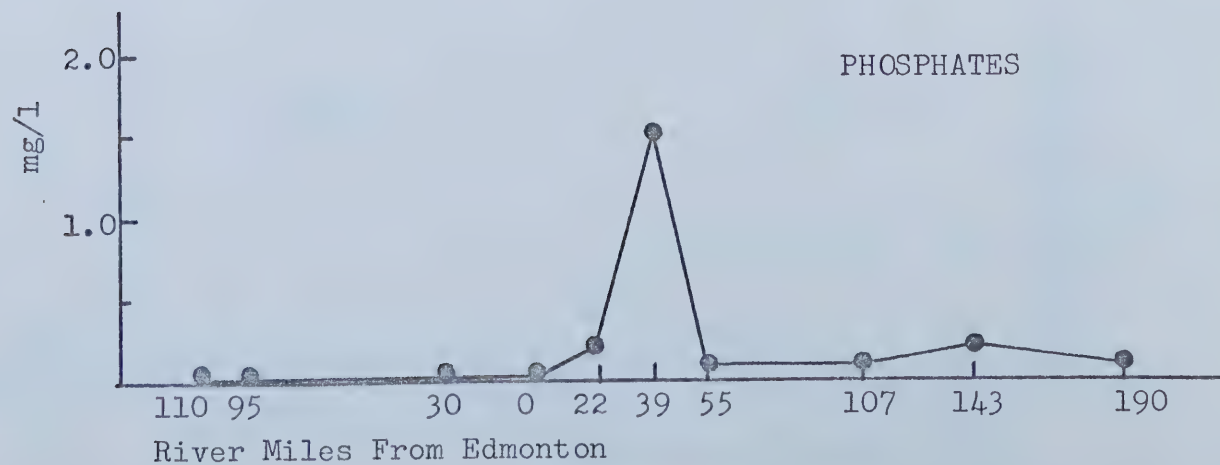
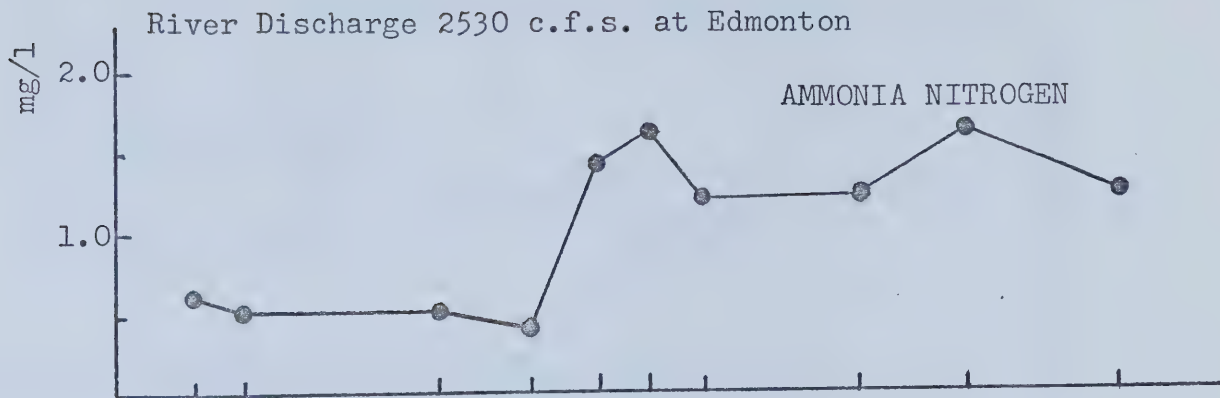
NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

February 1 - 2, 1972

River Discharge 2530 c.f.s. at Edmonton



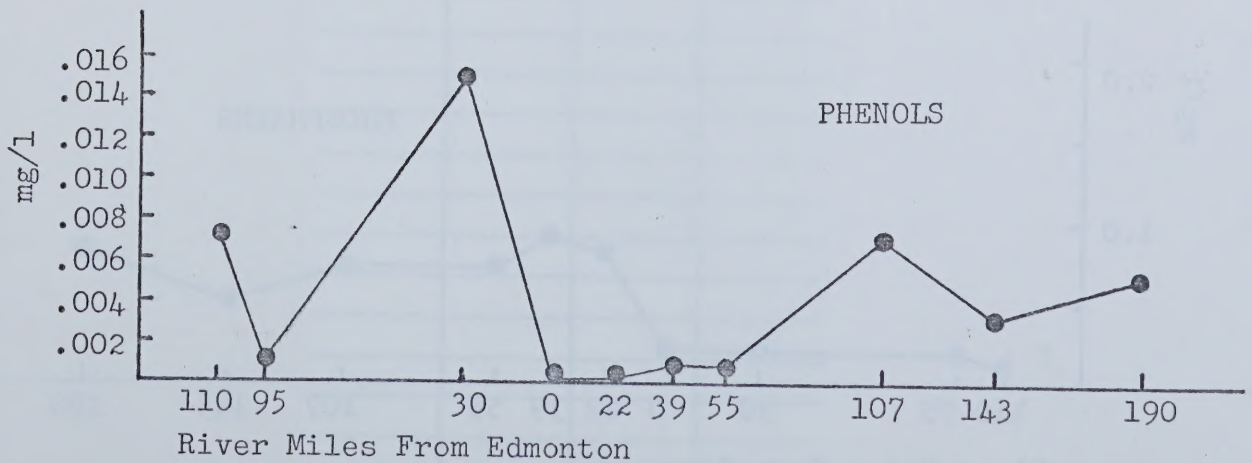
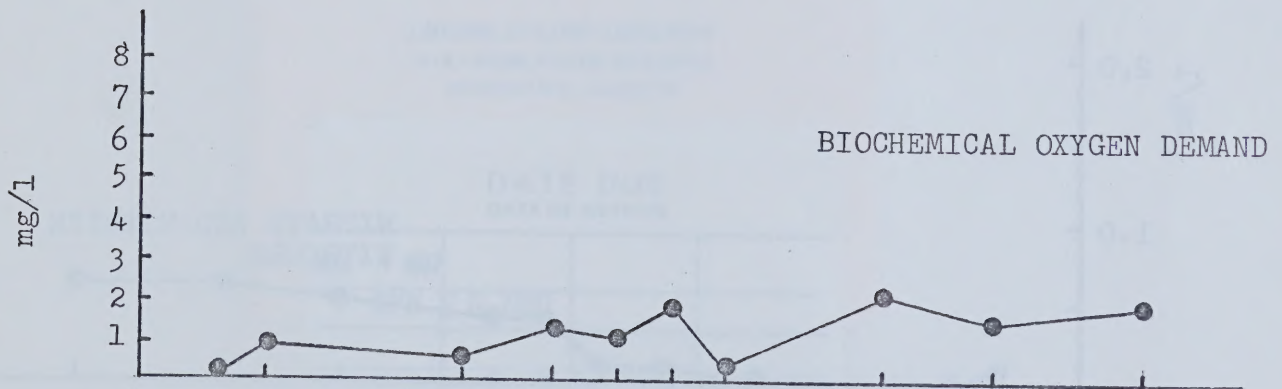
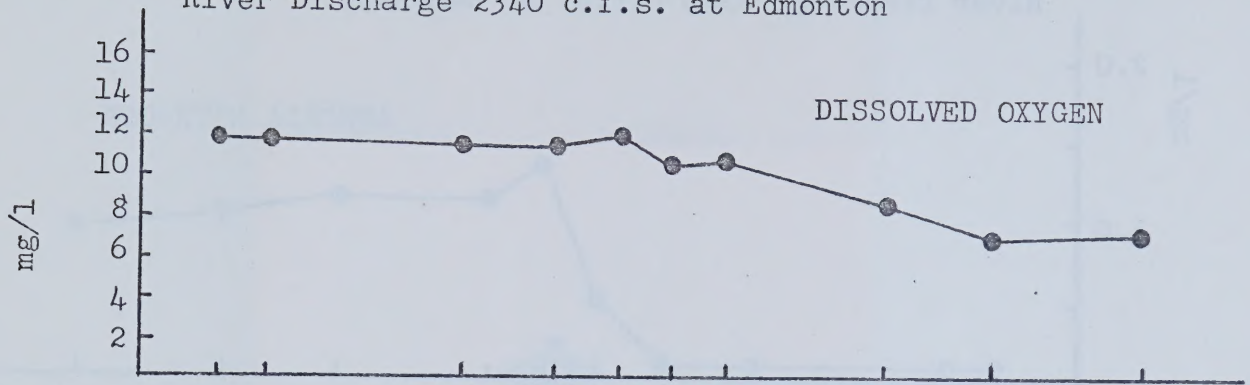
NORTH SASKATCHEWAN RIVER SAMPLING RESULTS
February 1 - 2, 1972



NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

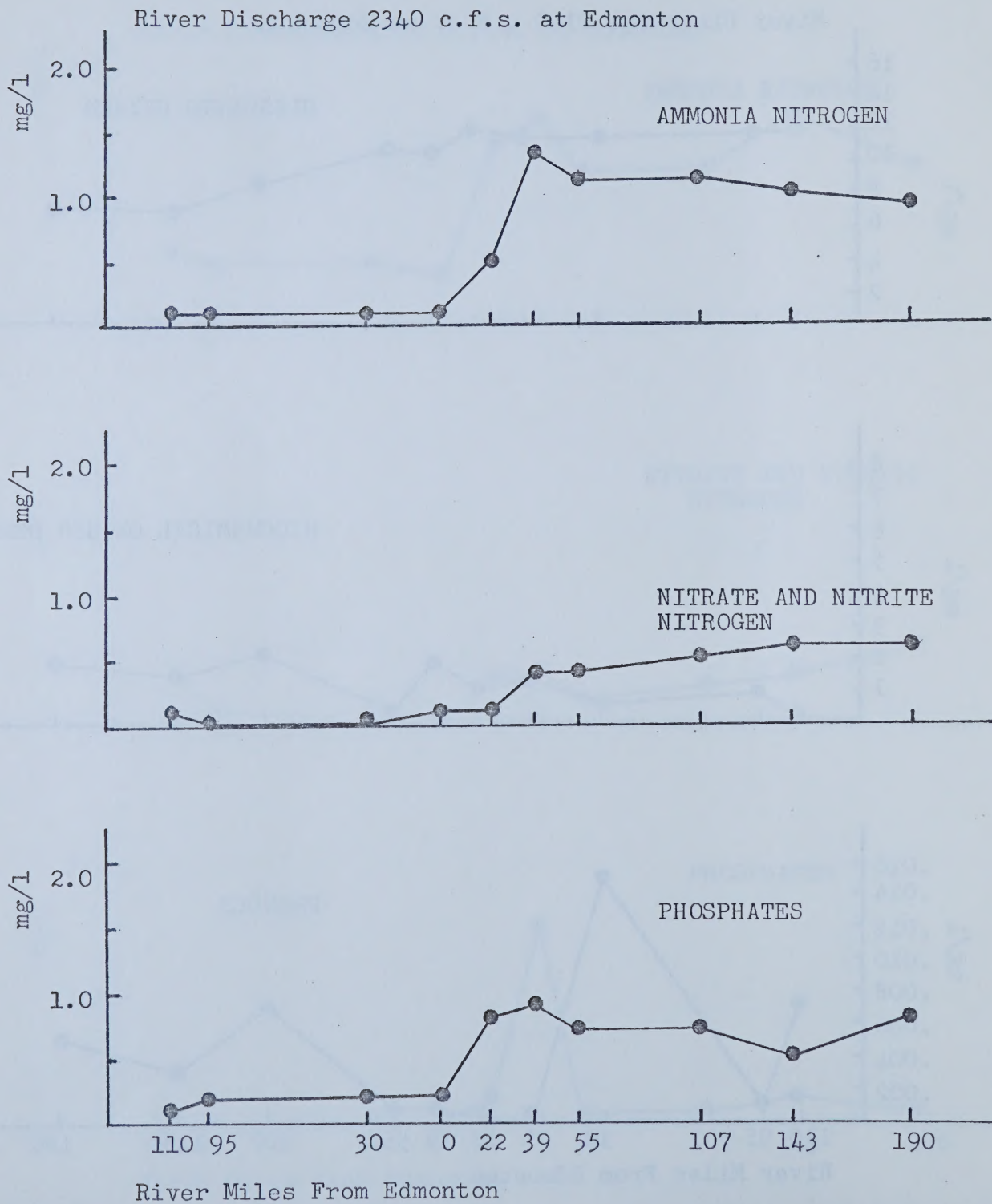
February 29 - March 1, 1972

River Discharge 2340 c.f.s. at Edmonton



NORTH SASKATCHEWAN RIVER SAMPLING RESULTS

February 29 - March 1, 1972





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